Submission FIN 00887-18: Budget Options: Carbon Tax

TO:	Minister	AUTHOR:	Niall O'Sullivan
STATUS:	Completed	OWNER:	Niall O'Sullivan
PURPOSE:	For Decision	REVIEWERS:	Niall O'Sullivan Gerry Kenny John Hogan Margaret Fitzgerald
DIVISION:	Tax Division		
DECISION BY:			

Final comment

I am currently minded to implement a €10 increase on Budget Day. Please inform me of options re. rebate scheme for hauliers/bus & view of DSP on best mitigation measures, e.g. deferral till May or/and any social welfare changes. Could I be informed of this by middle of this week. Furthermore there are additional measures proposed in DN letter specifically asks for a price floor, lower VAT on lower smoke fuels, & further measures on page 5&6 of letter. Could I get views, partic. on re-purposing of HRI? PD 16/09/18 (see copy of attachment below)

Action required

To note Budget options relating to the Carbon Tax

Executive summary

- Increasing the carbon tax rate would support climate change policy and would send a signal to consumers and renewable energy investors about the policy stance.
- In order to meet climate change targets, which currently appears difficult, there have been calls for a long term strategy to increase the carbon tax rate to €80 (per tonne CO_2) by 2030. The current rate of €20 has been in place since 2012.
- The ESRI were commissioned to draft a report modelling carbon tax increases from the current rate of €20 to €25, €30, €35 and €40 respectively.
- The report, when finalised, will find that increasing the rate by €5, to €25, would have relatively modest impacts across environmental, social and economic criteria.
- Increasing the carbon tax to €25 or €30 would raise about €105m or €210m respectively.
- Increasing the carbon tax may disproportionately impact low income households already in or at risk of fuel poverty, as well as businesses with particularly large energy expenditures.
- Possible measures to mitigate some of the distributional impacts of a carbon tax increase include a rate increase in the National Fuel Scheme. The Diesel Rebate Scheme will absorb a certain amount of a carbon tax increase for qualifying hauliers and bus operators.
- Options are set out in this submission to increase the Carbon Tax while options can be provided in respect of the Diesel Rebate Scheme if it is considered appropriate to increase rates.

Detailed information

Carbon Tax and Diesel Rebate Scheme

Carbon Tax

1. **Background to Review of Carbon Tax**

1.1 In line with commitments made in the National Mitigation Plan, in Budget 2018 you announced that the ESRI were to carry out a carbon tax review to inform decisions in Budget 2019.

1.2 The rate of carbon tax has been €20 per tonne of CO2 since 2012. The Climate Change Advisory Council advocates for the rate to be increased to €80 by 2030, recommending it be increased to €30 in Budget 2019. Minister Naughten (see attached correspondence) advocates the same long-term approach to *'act as a powerful signal for private investment decisions, re-orientating them towards decarbonising options'*.

1.3 A general context is that, at the current trajectory, Ireland is not close to meeting its climate change targets, not helped by the fact that there has been an increase in CO2 emissions from transport since 2012[1], from residential homes since 2014[2], and there remains a continued over-reliance on carbon intensive fuels such as oil, coal and peat[3].

1.4 Even strong advocates for carbon tax increases recognise that it could disproportionately impact households in or at risk of fuel poverty. Households dependent on more carbon intensive fuels such as oil and solid fuels are more likely to experience fuel poverty.[4] Therefore, it has been recommended that existing complementary policies and mitigating measures be enhanced in conjunction with any increases in the carbon tax.

1.5 To some extent, successful complementary measures are already in place. For example, the SEAI operate the Better Energy Warmer Homes Scheme which provides grants for the full costs of energy efficiency improvements in the homes of the elderly and most vulnerable to fuel poverty. This scheme has provided grants to date to over 130,000 low income households with the average cost of €3,000 per home upgraded in 2017. Nonetheless, the SEAI Building Energy Rating database shows that 24% of rated houses achieve poor energy efficiency ratings of E, F and G, unchanged since last year's review despite over 60,000 new ratings in the data set since the last report.

1.6 In terms of mitigating measures, the National Fuel Scheme overseen by the Department of Social Protection provides winter grants to low income households, while the Diesel Rebate Scheme provides a level of support for qualifying hauliers and bus operators in the transport sector.

2. ESRI Study modelling increases in the Carbon Tax

2.1 The ESRI has forwarded a draft paper to the Department which assesses the environmental, economic and social impacts of an increase in the tax (attached). It is intended that the final paper will be published on Budget Day.

2.2 The paper has certain research limitations. For example, an inability to model multi-annual impacts of various carbon tax scenarios, to adjust for cross border flows (in the context of significant existing fuel tourism), to adjust for any offsetting taxation measures (e.g. specific income tax reliefs for farmers to compensate for carbon tax, diesel rebate scheme, etc.). This means that a certain level of subjectivity can be assumed in relation to estimated emission reductions and distributional impacts across household income deciles[5].

2.3 The main findings of the research are that:

- a €5 increase was found, in a 'good case' scenario, to reduce national (non ETS) emissions by 1.76% annually (it is understood that this may be revised downwards to 1.1-1.2% when the final paper is published).

- the impact on fuel poverty of increases of €5 or €10 is not deemed to be significant, though an increase in the tax is deemed to have a moderately regressive character in respect of transport.

    - a €5 increase was found to modestly add to annual household costs, working out at about €34 for the poorest 3 income deciles, €66 for the middle 4 income deciles and €108 for the wealthiest 3 deciles.

- the impact of increases of €5 or €10 on prices and production sectors is not deemed to be significant overall.

    - the sectors most exposed to price increases are those most reliant on diesel, like transport, though a €5 increase was found to increase land transportation service prices by just 0.267%. A €5 increase in Carbon Tax adds 1.64 cent VAT

inclusive to a litre of diesel.

3. Cross border issues

3.1 A small increase in the carbon tax may have limited cross border effects, though embarking on a long term policy to increase the carbon tax to €80 could have significant impacts on cross border energy transactions, particularly if the UK does not follow suit and/or if sterling continues to weaken.

3.2 Fuel tourism is an issue that is a double edged sword: a recent ESRI study[6], estimated that fuel tourism generated €230m in (transport) taxes for the South but also added about 2% to our GHG emission levels. According to the most recent AA fuel price data[7] the average cost of petrol in the South is €1.438 while in Northern Ireland it is £1.278. At an exchange rate of €1 = £0.89 that means that petrol prices are now, on average, about the same North and South.

3.3 Further, arising from significantly higher taxes on solid fuels in the South (VAT rate higher by 8.5% plus a carbon tax of €2.40 per 40kg bag) there are ongoing issues regarding the illicit sale of solid fuels in the South. This includes high sulphur coal which is damaging to public health, jeopardises legitimate businesses in the South as well as depriving the Exchequer of Revenue. The Local Authorities (responsible for enforcing Air Pollution Regulations) and the Revenue are working together to combat this illicit trade.

4. Consumer Impact

4.1 The table shows the current impact of the carbon tax as well as the impact of a €5 increase.

FUEL TYPE	CURRENT TYPICAL RETAIL PRICE [8]	CARBON TAX AT €20 (INCL VAT)	IMPACT OF €5 INCREASE (INCL VAT)
Petrol	143.8c per litre	5.6c	+1.41c
Diesel	134.2c per litre	6.6c	+1.64c
Peat	€4.50 for a 12.5KG bale	52c	+13c
Coal	€18.33 for a 40kg bag of coal	€2.40	+60c

4.2 In relation to natural gas for home heat, the Energy Regulator (CRU) estimates that the average household uses 11,000 kilowatt hours of gas per year, which attracts a carbon tax at the current rate of c€46. A €5 increase in the carbon tax would therefore add about €11.50 to the gas bill of an average household. In relation to kerosene for home heat, there is no official data on average household use, though it is likely that the average household would pay significantly more in carbon tax than one reliant on gas. (households reliant on kerosene for home heat may, on average, be bigger than the average household using gas and have a lower BER rating).

4.3 The cost of the carbon tax will vary significantly between different households depending on things like household income levels, the BER rating of the home, whether it's on the gas network, the availability of good public transport, etc. SEAI research shows a clear urban/rural divide between sources of home heat, with gas being particularly popular in urban areas while oil and solid fuels are particularly popular in rural areas. DCCAE research shows that Ulster and Connaught (excl. Galway) have by far the highest proportion of households in fuel poverty[9].

4.4 Similarly in relation to transport, CSO data[10] shows that people living outside of Dublin have a greater dependence on private passenger cars as a mode of transport and travel greater distances. About 40% of carbon tax receipts is accounted for by diesel, by far the largest contributor to the tax.

5. Options for increasing the Carbon Tax rate

5.1 The Carbon Tax took in €420m in 2017. Receipts from Carbon Tax are -€24.1m (-9.1%) below target (€433m) for the first seven months of 2018.

5.2 An increase of €5 per tonne would generate c€105m in a full year and a €10 increase would generate c€210m in a full year. [11]

5.3 Some pros and cons of increasing the carbon tax rates are set out in the table below.

CARBON TAX INCREASE: PROS	**CARBON TAX INCREASE: CONS**
Is in line with Climate Change policy as set out in the Programme for Partnership Government and the National Mitigation Plan.	Increases, however marginally, the costs of doing business, home heating and commuting.
Positively contribute to Ireland's binding EU climate targets which we are currently exceeding and on a wrong trajectory.	May disproportionately impact businesses and households for whom there may be no available or affordable substitute energy products.
Further incentivises investment in and the adoption of cleaner energy alternatives. More generally, sends a signal about the use of fossil fuels and its impact on the environment.	Cross border: will increase the current incentives to (illegally) sell solid fuels in the South. In the context of a weakening sterling, may reverse some of the fuel tourism resulting in a reduction in Exchequer revenues.
Raises significant revenues	Comes at a time when fuel prices have increased by c10% in the last year

5.4 In the event that you are minded to increase the carbon tax rate please note that increases in the solid fuel carbon tax have historically been implemented from 1 May of the following year to allow for the winter fuel season cycle elapse. This delay could reduce receipts by some €3-4m.

Diesel Rebate Scheme

6.1 Increasing the rate in the Diesel Rebate Scheme may mitigate the impact of a carbon tax increase for certain hauliers and bus operators, for whom diesel expenditure is a particularly big business expense and in the context of there being no realistic cleaner energy alternatives currently available to them.

6.2 A counter view is that the Diesel Rebate Scheme, without any rate changes, will partially compensate hauliers and bus operators for carbon tax induced price increases; that they receive VAT refunds in any event; and long term this compensatory mechanism only serves to reduce the incentives for them to invest in any emerging cleaner energy alternatives.

6.3 The Diesel Rebate Scheme, introduced in 2013, offers a partial excise refund to qualifying hauliers and bus operators based on the retail price of diesel. The rebate kicks in when the price at the pumps goes above €1.23 per litre; increasing gradually to a maximum rebate of 7.5c when diesel reaches €1.54 per litre. Currently the average retail price of diesel is about €1.36, which entitles qualifying businesses to a rebate of about 3.1c per litre.

6.4 The relatively low price of oil has resulted in minimal costs for the scheme over recent years (€1.3m in 2016; €964,000 in 2017; Less than €400,000 for first half of 2018). It is understood that not all businesses who would qualify for the scheme choose to apply, for their own commercial reasons (e.g. related to scheme rules applied by Revenue), or that some qualifying businesses continue to purchase some of their fuel abroad (e.g. the price of diesel is significantly cheaper in Luxembourg).

6.5 The IRHA, in their pre-Budget submission, have requested an increase in the maximum rebate received to 15c per litre similar to that offered in Belgium as well as a reduced threshold at which the scheme activates. It should be noted that in Belgium a

road user charging system was introduced in 2016 and the rebate scheme is designed to offset the increased costs which range from 7c to 30c per kilometre driven. It should also be noted that while excise on diesel in Ireland is not low by EU standards, there are several EU Member States with high, sometimes significantly higher, excise rates. Also in Budget 2016 the rate of motor tax applicable to commercial vehicles was reduced, in many cases resulting in an annual saving to hauliers in the thousands.

6.6 If there is a view that it is appropriate to introduce mitigation measures for hauliers and bus operators, we can provide options in that regard.

6.7 You may wish to discuss with officials.

29th August 2018

[1] Energy related CO2 emissions in Ireland 2005-2016, 2018 Report, SEAI.

[2] Ibid

[3] According to SEAI in 2015, the average Irish home used 7% more than the average EU home but emitted 58% more CO2 due to greater use of high-carbon fuels including coal, peat and oil.

[4] See DCCAE 'Bottom Up Analysis of Fuel Poverty in Ireland', 2015.

[5] For example, the estimated reductions in (non ETS) national emissions arising from a €5 increase in the carbon tax in the attached paper is 1.76% annually. ESRI researchers have reviewed this optimistic forecast and the figure in the published paper is, we understand, likely to be 1.1% or 1.2%, a very significant reduction. Another example is that the ESRI researchers are using a mixture of sources to estimate impacts of household income deciles (which led to some revisions).

[6] See https://www.esri.ie/pubs/JA201762.pdf

[7] See https://www.theaa.ie/aa/motoring-advice/petrol-prices.aspx and http://www.theaa.com/driving-advice/driving-costs/fuel-prices

[8] See https://www.theaa.ie/aa/motoring-advice/petrol-prices.aspx and

https://www.seai.ie/resources/publications/Domestic-Fuel-Cost-Comparison.pdf (prices at July 2018)

[9] See DCCAE 'Bottom Up Analysis of Fuel Poverty in Ireland', 2015

[10] See CSO National Travel Survey 2016.

[11] There is likely to be a very small offset to these figures in the form of claims to the Diesel Rebate Scheme (at current diesel retail prices, the current rate provides for a rebate of 24.4% of the VAT inclusive diesel price increases to qualifying hauliers and bus operators).

Related submissions

There are no related submissions.

Comments

Gerry Kenny - 29/08/2018 16:19
As discussed

John Hogan - 13/09/2018 12:39

Minister the paper sets out options in relation to increases in the Carbon tax. You may also wish to consider any necessary expenditure measures to protect vulnerable groups.

Helena Quane - 18/09/2018 09:29
I am currently minded to implement a €10 increase on Budget Day. Please inform me of options re. rebate scheme for hauliers/bus & view of DSP on best mitigation measures, e.g. deferral till May or/and any social welfare changes. Could I be informed of this by middle of this week. Furthermore there are additional measures proposed in DN letter specifically asks for a price floor, lower VAT on lower smoke fuels, & further measures on page 5&6 of letter. Could I get views, partic. on re-purposing of HRI? PD 16/09/18 (see copy of attachment below)

User details

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The Impacts of Increasing the Irish Carbon Tax: a SAM-based Multiplier Analysis

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Abstract

This report investigates the impacts of increasing the current carbon tax in Ireland from €20 per tonne of CO_2 to €25, €30, €35 and €40. For this purpose, an Energy Social Accounting Matrix (ESAM) for Ireland is developed, which can track the flow of carbon inputs across production sectors and products throughout the Irish economy. The matrix comprises 32 activities (production sectors) and 38 commodities, the government sector and ten households types (based on income). Our results reveal that increases in the carbon tax affect the prices of diesel and gasoline the most. Overall the impacts of increasing the carbon tax by €5 on total production costs of sectors and total consumption costs of household are extremely small. Even for larger increases of carbon tax, the impacts remain low, where e.g. a doubling of the carbon tax will increase production costs by at most 1.2%. The most impacted household type will see an increase of consumer prices of 0.7% for a doubling of the carbon tax. Comparing impacts across household types, we find that impacts on consumer and energy prices tend to be higher for higher income households. Examining the impacts on heating, we find that effects on fuel poverty for households are practically uniform across income deciles. We tentatively estimate that economy-wide emissions are reduced by 1.75% for a €5 increase in carbon tax.

1 Introduction

The impacts of carbon emissions on our climatic system have long been recognised by the international academic community, where human-induced climate change is estimated to have increased atmospheric temperatures by over 0.8°C to date compared to pre-industrial levels (IPCC, 2014). Climate change involves, in addition to increases in temperature, more variability in temperature and precipitation, increased occurrences of extreme weather events and sea level rise. The concomitant impacts of these climatic changes on societies and economies are uncertain but are expected to be very significant, where at a global level economic damage of approximately 2% of GDP per year for a temperature increase of 2.5°C are estimated (IPCC, 2014). In the case of Ireland, impacts over the coming decades could include a.o. impacts of sea level rise on coastal areas, more intense storms and rainfall events, increased flooding, summer water shortages, increased risks of new pests and diseases and adverse impacts on water quality (Desmond et al., 2017). Impacts over longer periods of time and higher levels of climate change are highly uncertain and could result extremely high impacts, abrupt climate change and climatic tipping points.

The expected impacts of climate change have led to a global recognition of the need to limit climate change, where through the United Nations Framework Convention on Climate Change (UNFCCC) countries have negotiated over the past decades to combine efforts to decrease greenhouse gas (GHG) emissions. In 2015, the Paris Agreement was adopted and to date has been ratified by 194 states and the European Union, though the US has given notice to withdraw from the agreement. Within the Paris Agreement, members to the convention voluntary submit their national emission targets through Intended Nationally Determined Contributions (INDCs), which are to be updated at five year intervals. The EU has been on the forefront of international efforts to reduce GHG emissions and was the first major econ-

omy to submit its INDCs. The main elements of the EU INDCs are summarised in the EU 2030 climate and energy framework with defines three key targets to be reached by 2030: at least 40% GHG emission reduction (compared to 1990 levels), at least 27% share of renewable energy, at least 27% improvement in energy efficiency. The EU has also defined a longer term perspective on climate and energy policy for 2050, which further decreases emissions by 80-95% of 1990 levels.

To achieve these targets at the least cost, the EU has implemented a cap and trade system, namely the EU Emissions Trading System (ETS). It operates in all 28 EU countries as well as in Poland, Liechtenstein and Norway and covers 45% of EU GHG emissions. In this system, heavy energy using installations (power stations and industrial plants) and airlines in the EU have to buy emission allowance, which are auctioned based on the overall EU emissions cap. Each year companies need to surrender allowances to cover their emissions or face heavy fines. Companies can trade emissions throughout the EU ensuring that emissions are cut where it costs the least to do so. The cap is set to decrease emissions from the ETS sectors by 21% in 2020 (compared to 2005) and by 43% in 2030. Emissions in non-ETS sectors will need to be cut by 30% (compared to 2005), where the overall EU goal is translated into individual binding target for Member States based on the Effort Sharing Decision. The decision lays out annual emission allocations to member states based on relative wealth. The Effort Sharing Regulation further sets binding annual targets for member states from 2021 to 2030. Overall, the EU has shown a strong commitment to climate policy in the long run with increasingly stringent targets over time.

The non-ETS reduction target for Ireland is, along with that of Denmark and Luxembourg, the most challenging target in the EU, namely a 20% reduction compared to 2005 levels by 2020. Ireland also faces a renewable energy target of 16% of final energy use and 10% of energy use in transport. These targets are legally binding and should Ireland not meet its targets, it will face large fines. Recent estimates by the Environmental Protection Agency (EPA) of Ireland project that GHG emissions are to increase in most sectors in Ireland given the strong economic growth and the expansion of the agricultural sector (EPA, 2018). These estimates show that, at best, Ireland will achieve a 1% reduction of emissions by 2020 on contrary to its binding target of 20%. Though steps have been made to limit GHG emissions in Ireland through a carbon tax, it is evident that there is a strong need to improve climate policy in Ireland to reach its 2020 targets in order to avoid facing EU level fines and to contribute to the transition to a low carbon global economy.

To ensure a smooth and least cost transition to a low carbon economy, it is imperative that appropriate energy policies including a carbon tax pathway are designed. To assist in the design and implementation of sound energy policies, research is needed to increase our understanding of the macro economic implications of various policies and to investigate how different production sectors and household groups are affected to help to identify winners and losers of potential policies. Furthermore, there is a need to understand how climate policies may affect emissions through the behaviour of firms and households to ensure that policies will result in the needed emission reductions.

This report aims to shed light on the impacts of increasing the Irish carbon tax on both the economy, in terms of increased production costs across industries and increased consumption costs across household types, and the level of emissions through emission reduction responses to increased prices. For this analysis, an Energy Social Accounting Matrix (ESAM) is developed and applied in a multiplier analysis setting. The ESAM reproduces the structure of the economy in its entirety, including productive sectors, households and the government, among others, quantifying the nature of all existing economic transactions among diverse economic agents. An ESAM also includes energy flows and emissions in addition to the standard monetary flows. The explicit inclusion of emissions makes it possible to evaluate the emission reduction associated with a specific policy, such as a carbon tax.

The ESAM examines how inputs and outputs flow between sectors of the economy and finally result in final goods consumed by households. The explicit modelling of sectorial inter-linkages makes it possible to investigate the wider economic impacts of a specific shock or policy through the different transmission channels in the economy and the distributional impacts of policies whose effects may be transmitted through multiple markets. The nature of the methodology makes it very useful to examine the direct and indirect impacts of a carbon tax on the Irish economy.

Developing and applying an ESAM, we look at various carbon tax scenarios to investigate their economic and environmental impacts. We find that a €5 increase in carbon tax will have very small impacts on both production prices and consumer prices. Furthermore, it will have a small impact on emission reduction. To ensure Ireland's emissions targets are met, significantly higher increases in the carbon tax are a necessity.

This report is structured as follows; in the first section we present the methodology which describes the ESAM, the multiplier analysis and the post multiplier analysis. The second section describes the results of our analysis and the final section draws conclusions.

2 Methodology

This analysis is based on an ESAM which examines how intermediate inputs flow between production sectors of the economy and finally result in final goods consumed by households. An ESAM makes it possible to track energy inputs through the various production processes and hence to estimate the carbon emissions inherent in the different commodities. Using a multiplier analysis the implications of an increased carbon tax can then be tracked through the various production processes and commodities in the economy and the final impacts in terms of increased production costs and increased consumption costs for households can be estimated. In this section, the concept of an ESAM is first introduced, after which the Irish ESAM is discussed, finally the multiplier analysis and post multiplier emission reduction analysis methodologies are discussed.

2.1 The Energy Social Accounting Matrix

A SAM can be defined as an organised matrix representation of all transactions and transfers between different production activities (sectors), factors of production (labour, capital, and land), and institutions (households, corporate sector, government, and enterprises) within an economy and with respect to the rest of the world. A SAM is thus a comprehensive accounting framework within which the full circular flow of an economy (from income from production to factor incomes to household income to household consumption, and back to production) is captured.

A SAM depicts all the transactions in the economy in the form of a symmetric matrix. Each economic agent is represented as both a row and a column account. The number of agents represented depends on the nature of the analysis. If a researcher wishes to explore the distributive effects of a policy change, there would be more than one households group. Each row of the SAM gives receipts of an account while the column gives the expenditure. An entry in row i and column j represents the receipts of account i from account j. The total of each row has to be equal to the total of the corresponding column. The logic behind this rule is simple; an expenditure of one agent is income of another agent and an agents income should equal its expenditure.

Genrally Input-Output (IO) tables are used to construct SAMs, IO tables are constructed based on supply and use tables (SUTs) which provide the most detailed data on the sources of supply and demand of commodities, the cost of production and taxes and subsidies on products. Industries are on the rows of SUTs while products are on the columns. The Supply Table provides information on which sectors produce which commodities, imports by commodities, trade margins[1], taxes and subsidies on products. The Use Table is formed by using four different tables for domestic use (usage of domestically produced products), import use (usage of imported products), net tax (tax less subsidies) on products, and lastly trade margins. Trade and transportation services are necessary to deliver commodities from factories and docks to markets. Producer prices[2] do not include the cost of these margins, since these are not part of the production process. These costs are paid by final users of commodities and are included in purchaser prices. Since a commodity is produced by several activities and the cost of margins is paid by consumers, margins are demanded by commodities. Each statistical office produces an IO table by using SUTs based on either product technology or industry technology assumption[3] and regardless of the choice of conversion, each industry is associated with one product in its production process. In other words, IO tables restrict the information provided by SUTs and do not allow industries to produce multi-products and do not allow commodities to be produced by multiple activities. However, secondary and tertiary products may play an important role for some industries and should therefore be included. The latter restriction leads to an ignorance concerning differentiated products produced by domestic industries.

[1] Usually, the supply table incorporates trade and transportation margins but in the case of Ireland, the Central Statistics Office (CSO) of Ireland provides only trade margin figures.

[2] These margins are one of the basic components of the valuation process. A brief explanation is provided on Appendix B. For further details, an interested reader is advised to see UN (1999); EUROSTAT (2008, 2013).

[3] Details of these assumptions are beyond the focus of this report. Details can be found in the aforementioned manuals.

In order to avoid the restrictions introduced by IO tables, a SAM can be constructed by directly using the SUTs. In this case, the domestic production can be represented more accurately while several complexities emerge such that each industry has to determine the level of production of each product.

As a SAM records incomes and expenditures, which are flow variables, it provides a snapshot of the economy for a period of time. Choosing a year for which a SAM is constructed, the base-year in other words, has important implications. By definition, a SAM depicts the economy in an *accounting equilibrium* where total expenditures is equal to total incomes for each agent. However, *economic equilibrium* requires that each agent does not tend to and has no incentive to change her/his behaviour. In other words, the decisions of agents are stable which, in turn, requires stability of prices including commodity prices and factors of production prices since the latter determines income (cost of production) of households (firms) and the former determines consumption profiles of agents. Therefore, theoretical limitation in choosing a base-year requires choosing a year in which prices are *relatively* stable.

An ESAM, includes a further disaggregation of commodities and activities to include energy inputs and emissions. This disaggregation is based on energy related data. There is no general practice when it comes to including the energy components in a SAM, as there is no consistent energy data source available across countries such as the SUTs are available when constructing the SAM. The inclusion of energy is based on the data available for that country and will differ concerning the method used as well as the level of detail. Below we shortly discuss the method we have used to incorporate energy elements into the ESAM for this report.

2.2 Structure of the Irish ESAM

Based on the discussion of the base-year choice and availability of data, 2011 and 2014 are candidates to be the base-year for the case of Ireland. The latest IO table and SUTs are available for the year of 2011 while only the SUTs are available for the year of 2014. Since we do not need an IO table and want to use the latest available data, 2014 is chosen as the base-year. The information for 2014 is more accurate than that of 2011 since it reflects changes in production and consumption patterns in the Irish economy after the global financial crisis of 2008-9.

A SAM can be constructed for a country, a region or a territory and the choice depends upon the focus of analysis. The SAM used in this study represents the entire Irish economy due to the fact that required data especially on inter-sectoral flows, inter-regional flows of commodities, etc. are not available at a regional level.

2.2.1 Activities and Commodities

The SUTs for 2014 provide information on 58 industries and 58 products. These industries / products are aggregated into 29 industries / products by taking into account relative weights of sectors in total value added and employment and also by considering the importance of sectors in energy-environment related analyses. These aggregated sectors with their abbreviations and NACE codes are shown in Table 1.

Table 1: Originally Aggregated Sectors

Abbreviation	Name	NACE Codes
AGR	Agriculture	1-3
MQE	Mining, Query and Extraction	5-9
FBT	Food, Beverage and Tobacco	10-12
TEX	Textile	13-15
WWP	Wood and Wood Products	16
OIN	Other Industry	17,18,33
PET	Petroleum; furniture; other manufacturing	19,31,32
CHE	Chemicals and chemical products	20
BPP	Basic pharmaceutical products	21
RUP	Rubber and plastics	22
ONM	Other non-metallic mineral products	23
BFM	Basic and Fabricated Metals	24-25
HTP	High-Technology Production	26-28
TRP	Transportation	29-30
EGS	Electricity and Gas Supply	35
WAT	Water and Sewerage	36,37-39
CON	Construction	41-43
TRD	Trade Activities	45-47
LTS	Land Transportation Services	49
WTS	Water Transportation Services	50
ATS	Air Transportation Services	51
ACC	Accommodation and Related Services	55-56,79
TEL	Telecommunication	61
FSR	Financial Services	64-66,77
RES	Real Estate Services	68
PUB	Public Administration	84
EDU	Education Services	85
HHS	Human, Health and Social Work	86-88
SER	Services	remaining

2.2.2 Energy Disaggregation

In order to conduct more accurate analyses of the effects of environmental policies on the Irish economy, several of the energy related sectors (activities and commodities) in the CSO SUTs given in Table 1 need to be further disaggregated to the desired level of detail. These sectors have to be disaggregated in such a way that different energy- and environment-related sectors / commodities are represented in both production activities and consumption baskets of final consumers. This process involves distributing the total value of the original sector over the newly created sectors for the activity and commodity rows and columns in the SAM. The disaggregation process requires not only obtaining information on production activities including intermediate input demand composition, composition of value added by factors of production, etc. but also distribution of final consumption across private (household) consumption, public consumption, consumption by investment purposes (investment by origin), and exports. The sectors that need to be further disaggregated are Mining, Quarrying and Extraction (MQE), Petroleum, Furniture and Other Manufacturing (PET) and Electricity and Gas Supply (EGS).

In the case of Mining, Quarrying and Extraction (MQE) a distinction needs to be made between energy and non-energy mining. Energy mining needs to further be disaggregated into peat, coal (which is imported) and natural gas. Other mining includes metal ore, stone, sand and clay. Based on the Exiobase IO model (de Koning et al., 2011), the CSO SUTs for 2007 (where energy and non-energy mining is separated), SEAI price data, CSO trade data and the EUROSTAT material flow data[4], we disaggregate the different mining and quarrying commodities and activities.

In the CSO SUTs, Petroleum, Furniture and Other Manufacturing (PET) has been aggregated to avoid data confidentiality issues, where firstly petroleum will need to be disentangled from furniture and other manufacturing. This is done using the EUROSTAT SUTs for the EA19 and CSO data concerning the total production and value added of the "Petroleum" sector and the "Furniture and Other Manufacturing" sector. The Petroleum commodities then need to be further disaggregated, in order to reflect the compositions of private consumption and intermediate input, into gasoline, kerosene, fuel oil, LPG, diesel and other petroleum products (petroleum coke, refinery gas, naphtha, bitumen, white spirit and lubricants). This is done on the basis of the SEAI Ireland Energy Balance 2014, which presents national energy statistics on energy production and consumption in Ireland. The flow of energy from production, transformation and energy sector own use through to final consumption in different sectors of the economy is given in energy units (ktoe). This is then converted into monetary units using different fuel prices derived from a.o. SEAI price data, CSO trade statistics and global fuel prices.

The Electricity and Gas Supply sector (EGS) needs to be disaggregated into Electricity and Gas. This is again done using the SEAI Energy Balance data and price data and CSO trade statistics.

Once the different sources of carbon have been separated in the ESAM (coal, crude oil, peat, natural gas, gasoline, kerosene, fuel oil, LPG, diesel and other petroleum products), the corresponding carbon emissions can be calculated. This is done by using fuel specific conversion factors provided by the SEAI, which give the tonnes of carbon for a kilo-tonne of oil equivalent (ktoe) of energy derived from each specific fuel. Carbon tax data is collected from the Revenue Commissioners excise receipts data and applied to each carbon commodity.

In this respect, the aforementioned production sectors are disaggregated into several sectors including peat, gas, other mining, petroleum, furniture and other manufacturing, and electricity, i.e. 32 sectors in total. Moreover, additional commodities are included, namely gasoline, kerosene, fuel-oil, liquid petroleum gas (LPG), diesel and other petroleum products. In addition to these domestically produced commodities, the disaggregated SAM also comprises crude oil and coal which are not produced within Ireland while both of them are demanded as intermediate inputs by refineries and other energy-related sectors and the latter is also demanded for final consumption purposes. Finally, there are 38 commodities in total.

It is important to note that in this analysis, we have focussed on carbon commodities and CO_2 emissions and do not include other sources of GHG emissions. In Ireland, approximately 30% of GHG

[4] For further details, see http://ec.europa.eu/eurostat/web/environment/material-flows-and-resource-productivity

emissions originate in the agricultural sector, where the bulk of emissions are non CO_2. The bulk of GHG emissions in agriculture come in the form of methane (CH_4) from ruminants and manure, which has a high capacity to trap heat in the atmosphere. Besides methane, nitrous oxide (N_2O) is emitted through fertisiler use and animal deposition. A carbon tax does not impact these emissions and further policies will need to be considered in order to limit agricultural emissions. Agricultural emissions discussed in this report refer to CO_2 emissions arising from the use of the above mentioned carbon commodities in agricultural production.

2.2.3 Households' Disaggregation

The households sector is disaggregated into 10 income deciles where the first household group $HH1$ refers to the poorest decile while the tenth group $HH10$ refers to the richest decile. In the disaggregation process, the available descriptive statistics provided by the CSO for the year of 2015 are utilised. These statistics comprises weekly average disposable income of each decile and its distribution across several sources. Summation of Employees-wages/salaries and self-employed income is treated as wage income whereas summation of investment income, property income, own garden/farm produce, and other direct income is treated as capital income which is used as a proxy of income from enterprises. Summation of the remaining items including retirement pensions, child benefit, older people pensions, and widows, widowers & guardian payments, etc. is treated as transfer income. Then, each household group's shares in these aggregated income items are calculated and total figures for households are distributed across households accordingly.

2.3 Methodology of Price Multipliers

Applying a price multiplier impacts of a shock in specific prices (such as a carbon tax) through different production sectors and commodities can be investigated. Applying this methodology, introduced by the seminal paper of Roland-Holst and Sancho (1995), the SAM accounts are divided into exogenous accounts, which are taken as given and determined outside the modelling framework and endogenous accounts which are estimated within the modelling framework. A change (shock) can then be implemented in the exogenous account and its impact on the endogenous accounts can be examined by assuming fixed quantities. Although it depends upon the focus of the analysis, the vast majority of the literature on SAM-based multiplier analysis assumes that the accounts of the government, savings-investments and the rest of the world are exogenous by referring to Round (2003, 6); *"government outlays are essentially policy determined, the external sector is outside domestic control and as the model has no dynamic features so investment is exogenously-determined"*. On the other hand, since the focus of this study is to investigate the effects of an increase in carbon tax, the government account needs to be endogenous.

In practice, the price multiplier methodology utilises the accounting equilibrium principle of the SAM and tracks prices of commodities and outputs through the columns of the SAM. In order to give an overview of the methodology, an artificial SAM is presented in Table 2 which includes two activities

Table 2: Artificial SAM (2 Activities x 3 Commodities)

	A1	A2	C1	C2	C3	F	H	E	T
A1			X_{11}	X_{12}	X_{13}				X_1
A2				X_{22}	X_{23}				X_2
C1	Z_{11}	Z_{12}					C_1	E_1	Z_1
C2	Z_{21}	Z_{22}					C_2	E_2	Z_2
C3	Z_{31}						C_3	E_3	Z_3
F	V_1	V_2							V
H						V_1+V_2			Y
E			L_1	L_2	L_3		S		E
T	X_1	X_2	Z_1	Z_2	Z_3	V	Y	E	

and three commodities. The SAM in Table 2 represents the Irish SAM constructed in which activities are allowed to produce multi-products. Therefore, the sub-matrix of activities and commodities in Table 2 has not only diagonal elements that represent *primary* products of respective activities but also off-diagonal elements that represent *secondary and tertiary* products of activities. This feature comprises the basic difference with the SAM used in IFPRI (2009) where sub-matrix of activities and commodities has only diagonal elements. Since the multiplier analysis requires neither formal representation of price relations nor multi-product determination decisions of activities, allowing for multi-products will result in prices of products produced by a single activity being equal to each other[5]. The artificial SAM is presented in Table 2 is converted into a coefficient format, where each column element is divided by the column total, this SAM in coefficient form is presented in Table 3.

Table 3: Artificial SAM in Coefficients (2 Activities x 3 Commodities)

	A1	A2	C1	C2	C3	F	H	E	T
A1			mb_{11}	mb_{12}	mb_{13}				X_1
A2				mb_{22}	mb_{23}				X_2
C1	ma_{11}	ma_{12}					mc_1	E_1	Z_1
C2	ma_{21}	ma_{22}					mc_2	E_2	Z_2
C3	ma_{31}						mc_3	E_3	Z_3
F	mv_1	mv_2							V
H						1			Y
E			l_1	l_2	l_2		s		E
T	1	1	1	1	1	1	1	E	

[5] On the other hand, in the CGE model under construction, levels of production for each product are determined applying a revenue maximisation problem in which price differentials across products are the major determinants. For technical details, see Punt (2013, Chapter 4).

By definition, for activities the value of total output should equal the value of total inputs and the following set of equations has to hold:

$$
\begin{aligned}
PX_1\, X_1 &= \sum_c PQ_c\, Z_{c,1} + V_1 \\
PX_2\, X_2 &= \sum_c PQ_c\, Z_{c,2} + V_2
\end{aligned} \tag{1}
$$

where the LHS is total value of output of activity a, that is equal to the summation of total costs of intermediate inputs and payments to factors of production. PX_a stands for price of output of activity a, PQ_c stands for price of commodity c and V_a represents payments to factors of production.

The following equation should hold to ensure that the value of total available supply of each commodity equals the sum of the supply of that commodity by each production sector plus the imports:

$$
\begin{aligned}
PQ_1\, Z_1 &= \sum_a PX_a\, X_{a,1} + L_1 \\
PQ_2\, Z_2 &= \sum_a PX_a\, X_{a,2} + L_2 \\
PQ_3\, Z_3 &= \sum_a PX_a\, X_{a,3} + L_3
\end{aligned} \tag{2}
$$

where the LHS is the total value of the supply of commodity c which must equal the supply of commodity c by activities and its imports. Dividing these equations by X and Z, respectively, yields the share of each component with respect to the respective column total such that:

$$
\begin{aligned}
PX_a &= \sum_c PQ_c\, \frac{Z_{c,a}}{X_a} + \frac{V_a}{X_a} \\
PQ_c &= \sum_c PX_a\, \frac{X_{a,c}}{Z_c} + \frac{L_c}{Z_c}
\end{aligned} \tag{3}
$$

Under the assumption of unitary prices which is also used in calibration process in a standard CGE model, the fractions in equation (3) are simply the coefficients given in Table 3;

$$
\begin{aligned}
PX_a &= \sum_c PQ_c\, ma_{c,a} + v_a \\
PQ_c &= \sum_c PX_a\, mb_{a,c} + l_c
\end{aligned} \tag{4}
$$

Solving these equations simultaneously for a change in levels of l_c which represents the share of the exogenous account in the SAM provided above, yields changes in prices of outputs and commodities. This is a simple illustrative example, the Irish SAM for the year of 2014 is much more complicated than the artificial SAM provided above, and results in the following set of equation used in this study;

$$
(1 - prodtax_a)\, PX_a = \sum_c PQ_c\, ma_{c,a} + \sum_f mv_{f,a}\, WF_{f,a} \tag{5}
$$

Here a production tax is subtracted from total output by activity a on the LHS of the equation. Equation (5) solves for output prices where $WF_{f,a}$ stands for the prices of factors of production f paid by activity a, where a production tax is subtracted $prodtax_a$ from total output by activity a on the LHS of the equation.

Equation (6) solves for commodity prices, where on the LHS a sales tax st_c is added on the commodity. The methodology employed in this study differs from the literature on SAM-based price multipliers due to the structure of this equation which is derived from the standard CGE literature. In reality, a commodity consumed within the domestic market is a composite of domestically produced and imported commodities and sales taxes are collected from the value of total consumption of this composite commodity. The first term in the parenthesis on the RHS of equation (6) is total value of consumption[6].

$$PQ_c \;=\; (\sum_a PX_a \; mb_{a,c} \;+\; l_c)\;(1+st_c) \tag{6}$$

As the methodology allows us to compute commodity prices, we can easily obtain changes in overall price level which is represented as consumer price index, equation (7), where wgt_c is the weight of commodity c in total private consumption.

$$CPI \;=\; \sum_c wgt_c \; PQ_c \tag{7}$$

Since the constructed SAM incorporates household deciles, we can also obtain household specific price indices by using wgt_c^{hh}, the weight of commodity c in total private consumption of household hh.

$$CPI^{hh} \;=\; \sum_c wgt_c^{hh} \; PQ_c \tag{8}$$

In addition to this household-specific consumer price index, two different energy-related price indices are also calculated. The first, namely $CPI_{hh,en}$, is the price index of all energy commodities while the second, namely $CPI_{hh,heat}$, is the price index of all heating related energy commodities, i.e. it excludes gasoline and diesel.

Another characteristic of this study is that the wage rate of labour in each activity is assumed to be changed at the rate of inflation. In the literature, factor prices are assumed to be constant but this is a restrictive assumption. Although wage rates are allowed to changed, the price of capital is assumed to be fixed, which is consistent with the fact that savings-investment account is assumed to be part of the exogenous account.

$$WF_{lab,a} \;=\; WF_{lab,a}^{base} \; CPI \tag{9}$$

[6] If we were follow the standard approach in the literature, equation (6) looks like $(1-st_c)\;PQ_c \;=\; \sum_a PX_a \; mb_{a,c} \;+\; l_c$

By using equations (5) and (6), we can derive the following equation in matrix notation

$$\left[1 - \frac{1+st_c}{1-prodtax_a}\, mb'_{a,c}\, ma'_{c,a}\right] PQ_c = mb'_{a,c}\,(1-prodtax_a)'\, mv'_{f,a}\, WF_{f,a} + l_c \tag{10}$$

where the second term in the parenthesis on the LHS is the price multiplier. It is evident that as sales tax rate, st_c, increases, the value of first term on the LHS of (10) declines. For the fixed level of the RHS where all components are exogenous in the bulk of the literature, commodity prices, PQ_c, have to increase. However, since factor prices, $WF_{f,a}$, are indexed to the overall price level, the RHS also increases which in turn puts further pressure on commodity prices.

2.4 Post-Multiplier Analysis

As mentioned above, the employed methodology explores the effects of a change on the exogenous accounts via prices by keeping all quantities including intermediate inputs fixed. Therefore, it does not allow us to draw conclusions concerning changes in emissions. In order to quantify the potential effects of changes in prices due to increases in the carbon tax, the following post-multiplier analysis is designed.

As saving-investment account is assumed to be fixed, sectoral capital stocks are also fixed. In addition to fixed employment, this implies that total value added remains fixed. The assumption of this methodology concerning fixed quantities holds for the total volume of outputs as well. As a result, the question of post-multiplier analysis is that *"what would be the changes in intermediate input compositions of activities due to increases in the carbon tax for the fixed levels of value added and output?"*. Similarly, households also alter their composition of consumption expenditures due to changes in prices for the fixed levels of disposable income.

It has to be noted that these results are obtained under restrictive assumptions and therefore should be interpreted with caution. The results can be interpreted as the direct effects of price changes. On the other hand, changes in energy-related input prices would also affect real value added and thus factor prices and market income of households. Moreover, changes in prices would also affect government revenues and thus transfers to households and disposable incomes of households. The methodology employed does not allow us to quantify these general equilibrium effects while the CGE model under construction (I3E) will be able to serve this purpose and examine the effects of a price change over several dimensions.

Production functions of activities are assumed to be in constant elasticity of substitution (CES) form

$$QX_a = sft\_qx_a \left[shr\_qx_{a,va}\, VA_a^{-rho\_qx_a} + shr\_qx_{a,ei}\, CEI_a^{-rho\_qx_a} + shr\_qx_{a,nei}\, CNEI_a^{-rho\_qx_a}\right]^{\frac{-1}{rho\_qx_a}} \tag{11}$$

where VA_a is value added, CEI_a is composite energy inputs, and $CNEI_a$ is composite non-energy inputs. Each activity solves a cost minimisation problem to choose the optimal levels of each component in the production function. These are as follows;

$$VA_a = \left(\frac{PX_a \, (1 - prodtax_a) \, shr\_qx_{a,va}}{PVA_a \, sft\_qx_a^{rho\_qx_a}} \right)^{elas\_qx_a} QX_a \tag{12}$$

$$CEI_a = \left(\frac{PX_a \, (1 - prodtax_a) \, shr\_qx_{a,ei}}{PCEI_a \, sft\_qx_a^{rho\_qx_a}} \right)^{elas\_qx_a} QX_a \tag{13}$$

$$CNEI_a = \left(\frac{PX_a \, (1 - prodtax_a) \, shr\_qx_{a,nei}}{PCNEI_a \, sft\_qx_a^{rho\_qx_a}} \right)^{elas\_qx_a} QX_a \tag{14}$$

where $PVA_a, PCEI_a$, and $PCNEI_a$ are activity-specific prices of value added, composite energy input, and composite non-energy input, respectively. It is evident that as price of a composite input increases, *ceteris paribus*, its optimal level declines.

Value added and composite energy inputs are also CES aggregates of factors of production and energy-related intermediate inputs, respectively, while composite non-energy input is Leontief amalgam of non-energy intermediate inputs, i.e. these inputs are complement.

$$VA_a = sft\_va_a \left[\sum_f shr\_fva_{f,a} \, FD_{f,a}^{-rho\_va_a} \right]^{\frac{-1}{rho\_va_a}} \tag{15}$$

where $FD_{f,a}$ is factor f (capital and labour) demand of activity a.

$$CEI_a = \left[\sum_{eni_c} shr\_cei_{c,a} \, INT_{c,a}^{-rho\_cei_a} \right]^{\frac{-1}{rho\_cei_a}} \tag{16}$$

where $INT_{c,a}$ is intermediate demand of commodity c by activity a. This composite commodity is defined over a set of energy inputs (eni_c) which comprises peat, coal, crude oil, natural gas, gasoline, kerosene, fuel-oil, LPG, diesel, electricity, and other petroleum products. Activities decide the level of energy inputs by solving a cost minimisation problem. The First order condition of this problem is

$$INT_{c,a}|_{eni_c} = \left[\frac{PCEI_a \, shr\_cei_{c,a}}{PQ_c} \right]^{elas\_cei_a} CEI_a \tag{17}$$

where $elas\_cei_a$ is elasticity of substitution across inputs, which following the general assumption of the literature is assumed to take the value of 2.

$$CNEI_a|_{neni_c} = \min \left\{ \frac{INT(1,a)}{shr\_cnei_{1,a}}, \ldots, \frac{INT(n,a)}{shr\_cnei_{n,a}} \right\} \tag{18}$$

where $neni_c$ is the set of non-energy inputs and comprises the remaining commodities. The level of each non-energy intermediate input is determined by

$$INT_{c,a}|_{neni_c} \ = \ shr\_cnei_{c,a}\, CNEI_a \tag{19}$$

Lastly, the following two equations are associated with $PCEI_a$ and $PCNEI_a$, respectively;

$$PCEI_a = \sum_{eni_c} \left[shr\_cei_{c,a}^{elas\_cei_a}\, PQ_c^{1-elas\_cei_a} \right]^{1/(1-elas\_cei_a)} \tag{20}$$

$$PCNEI_a = \sum_{neni_c} \left[shr\_cnei_{c,a}\, PQ_c \right] \tag{21}$$

Notice that, the price multiplier analysis allows us to obtain new values of PX_a and PQ_c. New set of these prices changes $PCEI_a$ and $PCNEI_a$ and relative costs of energy and non-energy intermediate inputs. Activities, by obeying the cost-minimisation rules, alter their intermediate input demand compositions, equations 17 and 19, for the fixed levels of value added and output.

After obtaining new values of intermediate inputs, we can calculate changes in activity-based emissions as follows

$$emis_a \ = \ \sum_{eni_c} emisints_c\, INT_{c,a} \tag{22}$$

where $emisints_c$ is the per unit emission intensity of commodity c. This parameter is calibrated by dividing the available emissions by commodities to the initial levels of total consumptions of the energy commodities, i.e. $QS0_c$.

The similar analysis is also carried out for the household sector by assuming that total volume of consumption is fixed. Households are assumed to get utility from composite consumption which is a CES aggregate of composites of energy and non-energy commodities

$$CC_{hh} \ = \ \left[shr\_u_{en,hh}\, CEN_{hh}^{rho\_u,hh} + shr\_u_{nen,hh}\, CNEN_{hh}^{rho\_u,hh} \right]^{-1/rho\_u,hh} \tag{23}$$

where CEN_{hh} and $CNEN_{hh}$ are composite energy and non-energy consumption of household hh, respectively. Households solve a cost minimisation problem to choose the optimal levels of these two components as

$$CEN_{hh} \ = \ \left[\frac{PCC_{hh}\, shr\_u_{en,hh}}{PCEN_{hh}} \right]^{elas\_u,hh} CC_{hh} \tag{24}$$

$$CNEN_{hh} \ = \ \left[\frac{PCC_{hh}\, shr\_u_{nen,hh}}{PCNEN_{hh}} \right]^{elas\_u,hh} CC_{hh} \tag{25}$$

where $PCC_{hh}, PCEN_{hh}$, and $PCNEN_{hh}$ are prices of composite consumption, composite energy consumption and composite non-energy consumption, respectively.

The composite consumptions are also CES aggregates of commodities. CEN_{hh} is an aggregate of energy commodities that are peat, coal, crude oil, natural gas, gasoline, kerosene, fuel-oil, LPG, diesel, electricity, and other petroleum products.

$$CEN_{hh} = \left[\sum_{eni_c} shr\_ue_{c,hh} \, CONS_{c,hh}^{-rho\_ue,hh} \right]^{-1/rho\_ue,hh} \tag{26}$$

$$CONS_{c,hh}|_{eni_c} = \left[\frac{PCEN_{hh} \, shr\_ue_{c,hh}}{PQ_c} \right]^{elas\_ue,hh} CEN_{hh} \tag{27}$$

where $CONS_{c,hh}$ is consumption of commodity c by household hh. Equation (27) is defined over the set of energy commodities.

$$CNEN_{hh} = \left[\sum_{neni_c} shr\_une_{c,hh} \, CONS_{c,hh}^{-rho\_une,hh} \right]^{-1/rho\_une,hh} \tag{28}$$

$$CONS_{c,hh}|_{neni_c} = \left[\frac{PCNEN_{hh} \, shr\_une_{c,hh}}{PQ_c} \right]^{elas\_une,hh} CNEN_{hh} \tag{29}$$

By using the similar argument, household-specific emissions can be calculated as follows

$$emis_{hh} = \sum_{eni_c} emisints_c \, CONS_{c,hh} \tag{30}$$

3 Results

The focus of this report is evaluating the effects of a €5 increase in carbon tax per tonne of carbon on commodities in the non-ETS sector. We also extend our analysis to investigate further increases in the carbon tax of €10, €15, and €20. We first give a brief overview of the current carbon tax in place after which we examine by how much the sales tax on each carbon commodity will increase if the carbon tax is increased. Using our price multiplier analysis, we then examine the distributional implications of an increased carbon tax for production sectors, where we focus on which production sectors face the highest production cost increases. The implications for household consumption prices are then investigated, with a focus on the increase in energy costs and the possible implications for fuel poverty. Finally applying our post multiplier analysis, we investigate the potential emission reduction associated with an increase in carbon taxes.

3.1 Current Irish Carbon Tax Policy

In 2009 a carbon tax was introduced in Ireland covering transport fuels (petrol and diesel). The tax was levied based on the carbon content of the fuels, applying a rate of €15 per tonne of carbon. In 2010, it was extended to include non-transport fuels (kerosene, marked gas oil, LPG and natural gas) and in 2013 solid fuels (coal and peat). Currently, the tax is levied on the supply of solid fuels, natural gas and mineral oils based on their carbon content, where a rate of €20 per tonne of carbon is applied. The tax applies to non-ETS sectors and excludes carbon used in electricity generation or as inputs to the production of

carbon products, though there is a minimum rate for all coal.

Table 4 shows the carbon taxes levied on the various form of carbon in 2014 in € millions. Our analysis is based on 2014, the latest year for which Supply and Use data is available, where total carbon tax levied is 390 million Euro. The latest carbon tax data is available for 2016 and is of a similar magnitude in total and across different carbon sources. Transport fuels (diesel and petrol) constitute a large share of the total carbon tax levied, though the carbon tax accounts for 7.6% of total excise duties levied on petrol and 14% of total excise duties on diesel. Overall carbon tax is relatively low, where total carbon tax constituted a mere 1.9% of total taxes levied on commodities in Ireland in 2014.

Table 4: Irish Carbon tax levied in €m for various fuels in 2014

Fuel type	€m
Diesel	147.6
Petrol	67.5
Marked Gas Oil	54.2
Natural Gas	51.7
Kerosene	42.3
Solid fuels (coal and peat)	17.2
LPG	7.6
Fuel Oil	1.8

3.2 Carbon Commodity Sales Tax

An increase in carbon tax of €5 will result in increased sales tax rates on carbon inputs, which is calculated as the share of sales tax in total supply value of each commodity. Table 5 gives the current sales tax, the computed new sales tax for carbon inputs and the percentage change in sales tax. Since other commodities are not taxed under the carbon tax, there are no changes in their sales tax rates. Although the other commodities do not pay carbon tax, interdependencies across activities and commodities affect all prices, i.e. as carbon input prices increase due to an increase in carbon taxes, prices of commodities using carbon inputs in their production will also increase.

Table 5: Sales Tax Rates by Carbon Commodities

	Sales Tax	New Sales Tax	Change, %
Peat	0.043	0.054	26.35
Coal	0.043	0.055	26.37
Natural Gas	0.015	0.019	25.48
Gasoline	0.683	0.705	3.24
Kerosene	0.021	0.026	25.66
Fuel-oil	0.003	0.004	16.07
LPG	0.040	0.050	25.50
Diesel	0.470	0.494	5.25

The second column is the original effective sales tax rate on energy commodities. The third column is the new tax rate after an increase in carbon tax by €5. the last column shows the percentage change in sales tax rate.

The impact that an increase in carbon tax will have on total sales tax of a given carbon commodity will depend on two factors. Firstly, the smaller the share of carbon tax receipts in total sales tax receipts, the smaller the impact of an increase in carbon tax. Table 5 illustrates this, where a high rate of sales tax is shown for gasoline (petrol) and diesel, 0.683 and 0.470 respectively. As discussed above, these sales taxes consist mostly of non-carbon excise duties. Therefore, a €5 increase in carbon tax has a relatively small impact on the total sales tax rates of these commodities, namely 3.2% for gasoline and 5.3% for diesel. On the contrary, the share of carbon tax receipts in total sales tax receipts is 64% for fuel oil, 97% for LPG, and 100% for kerosene, coal, natural gas and peat are larger resulting in larger impacts on the total sales tax. Secondly, to a lesser extend the carbon content of the carbon commodity has an impact on the change in total sales tax, where the sales tax of carbon commodities with higher carbon contents such as coal and peat are more impacted by an increase in carbon tax. This impact is rather small as the difference in relative prices of carbon commodities negates most of these impacts, i.e. the prices of carbon commodities are closely related to their carbon content.

3.3 Carbon Commodity Purchaser Prices

We now examine how purchaser prices will be impacted by an increase in the carbon tax. Table 6 shows the purchaser price increases of carbon commodities in percentages. It is clear from these results that increasing the carbon tax will not have extreme impacts on the prices of carbon commodities, where e.g. doubling the carbon tax to €40 per tonne will lead to an average 3.8% increase in purchaser prices for carbon commodities. Even when looking at diesel, which is the commodity with the highest change in purchaser prices, increases in purchaser prices are relatively small. For diesel a carbon tax of 40€, will result in an increase of purchaser price of 7.1%, this is comparable in size to the (exogenous) diesel price fluctuations faced by consumers in the first 5 months of 2018.

Comparing the impacts across carbon commodities, the results on Table 6 indicate that, despite the lowest percentage changes in sales tax rates, the most affected commodities are gasoline and diesel. The reason for this lies on the structure of the multiplier. The value of multiplier, the second term in the parentheses on the LHS of equation 10, depends on the structures of the matrices of *mb* and *ma* which show the composition of commodity production by activities and the composition of intermediate input by activities, respectively. In the latter, the relatively higher share of diesel shows the importance of this commodity in the production process.

3.4 Producer Prices

When interpreting the results here concerning producer and consumer prices, it is important to keep in mind the assumptions of the methodology applied. This methodology considers the initial impacts of a carbon tax, where producers and households to not adjust their behaviour in response to price changes. The advantage of this methodology is that it focusses on the initial impacts, which are generally the largest. As producers and consumers adjust behaviour these impacts can be negated to a degree. Simply

Table 6: Changes in Purchaser Prices of Carbon Commodities, in percentages

	€5	**€10**	**€15**	**€20**
Peat	1.134	2.294	3.482	4.698
Coal	1.097	2.218	3.364	4.536
Natural Gas	0.474	0.953	1.437	1.925
Gasoline	1.326	2.688	4.087	5.525
Kerosene	0.530	1.066	1.608	2.156
Fuel-oil	0.089	0.180	0.271	0.364
LPG	1.000	2.020	3.061	4.124
Diesel	1.691	3.439	5.249	7.123

Changes in purchaser prices of energy commodities due to an increase in carbon tax of €5, €10, €15 an €20.

put, we assume consumers do not change their consumption behaviour and feel the full force of the carbon tax, however in reality consumers will adjust their consumption bundles and consume less carbon intensive goods. The degree to which both producers and consumers will adjust their behaviour will depend on various factors. There is a role for the government here to incentivise consumers and producers further to switch to low carbon commodities through e.g. promoting/subsidising low carbon energy and sending a strong message of commitment to an increasing carbon tax.

Table 7: Changes in Producer Prices of Selected Activities in percentages

	€5	**€10**	**€15**	**€20**
Water Transportation Services	0.288	0.586	0.894	1.213
Land Transportation Services	0.267	0.544	0.829	1.124
Air Transportation Services	0.268	0.542	0.823	1.111
Natural Gas	0.189	0.381	0.575	0.771
Electricity	0.183	0.370	0.560	0.754
Peat	0.120	0.243	0.370	0.501
Agriculture	0.096	0.194	0.296	0.401
Accommodation and Related Services	0.086	0.174	0.264	0.358
Construction	0.068	0.137	0.209	0.282
Transportation	0.056	0.113	0.171	0.232
Food, Beverage and Tobacco	0.048	0.097	0.147	0.199
Textile	0.047	0.095	0.144	0.195
Petroleum	0.043	0.087	0.133	0.179
Chemicals and Chemical Products	0.032	0.065	0.098	0.132
Basic Pharmaceutical Products	0.019	0.039	0.059	0.080

Changes in producer prices of due to an increase in carbon tax of €5, €10, €15 an €20.

Examining the impacts of total producer prices across production sectors, we can gain a better understanding of those production sectors most affected by a carbon tax increase. Table 7 gives the percentage change in producer prices for the 15th most impacted production sectors, where the impacts on all production sectors are displayed in the appendix. The results of Table 6, where diesel and gasoline show the highest increases in prices, drive the results here where the transportation sectors have the highest increases in producer prices. The impact, however, remains small with a less than 0.3% increase in pro-

ducer prices in case of €5 increase in carbon tax. When an increase of €20 is applied, the effects become slightly higher than 1%. Among these services, the water transportation is affected the most since diesel is the main source of energy for the sector. Natural gas, electricity[7], and peat follow the transportation services. For the remaining activities, the effects are negligible.

3.5 Consumer Prices

An important issue concerning the implementation of a fair carbon tax is its distributional impact across different households. Here we examine how consumer prices are affected for different household types, where households types are distinguished based on their income, i.e. we examine income deciles. Table 8 presents these results, where the bottom row shows the effects of a carbon tax shock on the overall inflation measured by changes in the consumer price index. The inflationary impacts are quite low as carbon commodities comprise a relatively small share of total private consumption, namely 2.7% in diesel, 2.2% in gasoline and 2% in electricity. When examining the price impacts across household types, the household-specific CPI results indicate that the effects are the lowest for the poorest two deciles while the highest for the 7^{th} and the 6^{th} deciles. Although there is a negative correlation between the share

Table 8: Changes in Consumer Price Index, in percentage

	€5	€10	€15	€20
The Poorest	0.109	0.220	0.334	0.452
HH2	0.118	0.239	0.363	0.491
HH3	0.131	0.266	0.405	0.547
HH4	0.128	0.259	0.394	0.534
HH5	0.122	0.247	0.375	0.508
HH6	0.159	0.323	0.491	0.664
HH7	0.169	0.342	0.521	0.705
HH8	0.128	0.261	0.397	0.537
HH9	0.132	0.268	0.408	0.552
The Richest	0.128	0.260	0.396	0.536
Overall	0.135	0.274	0.416	0.563

Changes in household-specific consumer price indices due to an increase in carbon tax of €5, €10, €15 an €20. The bottom line shows the effects on the overall CPI.

of electricity in total household consumption and household income, i.e. as income increases the share declines, this is not the case for gasoline and diesel. The share of gasoline is 5% (4%) for the the 7^{th} and the 6^{th} deciles, respectively, while 1% (1.9%) for the poorest (richest) decile. In summary, an increased carbon tax does not make poorer households worse off as compared to richer due to the higher share of diesel and gasoline in the richer households consumption basket.

[7] Note that the impacts of a carbon tax on electricity are overestimated here, as a carbon tax on peat does not apply to the electricity sector but in this analysis cannot be disentangled from the carbon tax applied to peat for other uses. We also assume that the minimum charge for coal used in electricity generation increases by the same percentage as the carbon tax. These effects do not impact the other results significantly, but should be mentioned here.

An important policy issue in Ireland is that of fuel poverty. The impact of the carbon tax, and more importantly future potential increases in carbon tax, on fuel poverty need to be considered when implementing a carbon tax. Fuel poverty occurs when people are unable to afford to adequately heat their homes. This leads to people living in cold damp and thermally inefficient housing, which in turn results in adverse impacts on health. Fuel poverty affects predominantly low income households and is defined as a household that spends more than 10% of their disposable income on energy costs.

Table 9: Changes in Specific Consumer Price Indices,in percentages

	Energy CPI, %				Heating CPI, %			
	€5	**€10**	**€15**	**€20**	**€5**	**€10**	**€15**	**€20**
The Poorest	0.696	1.410	2.142	2.892	0.378	0.761	1.150	1.544
HH2	0.823	1.668	2.536	3.428	0.369	0.744	1.124	1.509
HH3	0.909	1.843	2.803	3.791	0.369	0.743	1.123	1.508
HH4	0.936	1.898	2.888	3.907	0.362	0.729	1.101	1.478
HH5	0.937	1.900	2.891	3.911	0.363	0.730	1.103	1.481
HH6	1.078	2.186	3.326	4.500	0.361	0.727	1.098	1.474
HH7	1.111	2.253	3.428	4.638	0.360	0.725	1.095	1.471
HH8	1.063	2.157	3.284	4.446	0.360	0.725	1.096	1.471
HH9	1.120	2.274	3.463	4.689	0.361	0.726	1.097	1.472
The Richest	1.123	2.278	3.469	4.696	0.361	0.726	1.096	1.471

Changes in household-specific specialised consumer price indices due to an increase in carbon tax of €5, €10, €15 an €20. The Energy CPI comprises all energy commodities while the heating CPI comprises all but gasoline and diesel.

To investigate the potential impacts of a carbon tax on fuel poverty, we calculate the change in the energy CPI where only energy-related commodities are included in the consumption bundle and the heating CPI which includes only heating costs. These impacts are is not lower than 0.7% for €5 increase in carbon tax since the price effects on these products are naturally relatively high among all commodities. On the other hand, the heating CPI which comprises all energy-related commodities but gasoline and diesel indicates that, although it is the highest for the poorest decile, the effects of an increase in carbon tax are quite uniform across household deciles. In other words, the dispersion of changes in the heating CPI is lower than that of the energy CPI. Overall impacts on heating prices are relatively small, where heating prices increase by around 0.4% for all households in the case of a €5 increase and around 1.5% for a €20 increase. This suggests that an increased carbon price will have small impacts on fuel poverty.

3.6 Emission Reductions

Here, we apply our post multiplier analysis to gain a tentative understanding of how producers and consumers may react to an increased carbon price and what the resulting impacts on emission reductions will be. Table 10 shows the changes in activity-based (production) emissions. Note that these results are based on changes in the compositions of intermediate demands of activities due to changes in relative prices of commodities under the assumption that the values of value added and output are fixed. In other words, we assume that an activity produces the same amount but uses different inputs to lower its production costs.

Given this assumption, activities substitute energy inputs for non-energy inputs which in turn lowers CO_2 emissions. Therefore, it can be said that the result on emissions are overestimated. Another important point should be noted that the results on emissions also reflect the non-linear structures, i.e. CES forms of demand functions, of energy related inputs for activities and commodities for private consumption. Basically, we assume that all carbon commodities can be substituted to a degree by non carbon commodities, in some sectors this may not be the case in reality. It is important to keep these caveats in mind when interpreting these results. It is again important to note that the behaviour of producers and consumers concerning switching to less carbon intensive commodities can be further encourage through a clear message concerning the commitment to a carbon tax and additional policies promoting less carbon intesive consumption.

Table 10: Changes in Selected Activity-Based Emissions, in percentages

	€5	**€10**	**€15**	**€20**
Agriculture	-3.107	-6.165	-9.174	-12.134
Land Transportation Services	-2.735	-5.431	-8.090	-10.710
Water Transportation Services	-2.711	-5.385	-8.022	-10.621
Construction	-2.531	-5.024	-7.480	-9.898
Peat	-2.257	-4.487	-6.688	-8.861
Accommodation and Related Services	-2.109	-4.189	-6.238	-8.257
Transportation	-1.917	-3.806	-5.668	-7.502
Electricity	-1.534	-3.055	-4.563	-6.058
Food, Beverage and Tobacco	-1.339	-2.665	-3.979	-5.280
Chemicals and Chemical Products	-1.231	-2.451	-3.659	-4.856
Textile	-1.114	-2.218	-3.312	-4.396
Air Transportation Services	-1.119	-2.224	-3.314	-4.389
Basic Pharmaceutical Products	-0.915	-1.825	-2.730	-3.631
Petroleum	-0.741	-1.473	-2.195	-2.908
Natural Gas	-0.575	-1.148	-1.719	-2.288

Changes in emissions of activities due to altered intermediate input compositions due to an increase in carbon tax of €5, €10, €15 an €20.

Examining the results, we see that agricultural emissions is reduced by 3.1% for a €5 increase in carbon tax which is the highest across the activities. Note here that we only examine carbon commodity related CO_2 emissions of the agricultural sector and do note consider other GHG emissions resulting from agriculture such as methane and nitrous oxide, i.e. we do not consider the bulk of GHG emissions resulting from the agricultural sector. As can be expected we see relatively high decreases in emissions by water and land transportation services and construction.

Considering household emissions, Table 11 shows that the reduction in emissions are the highest for the 8^{th} and the 9^{th} deciles and the lowest for the poorest decile. This result is in line with the notion that poorer households consume more essential energy goods, making the reduction of consumption of energy goods less likely, while richer households consume more non-essential energy goods where substitution with other goods are more likely.

Table 11: Changes in Household Emissions, %

	€5	€10	€15	€20
The Poorest	-1.852	-3.685	-5.499	-7.293
HH2	-1.995	-3.968	-5.919	-7.848
HH3	-2.067	-4.112	-6.134	-8.134
HH4	-2.132	-4.240	-6.324	-8.384
HH5	-2.127	-4.229	-6.307	-8.360
HH6	-2.194	-4.366	-6.515	-8.641
HH7	-2.195	-4.369	-6.521	-8.650
HH8	-2.273	-4.519	-6.738	-8.929
HH9	-2.334	-4.640	-6.918	-9.169
The Richest	-2.311	-4.594	-6.850	-9.079
Total	-1.757	-3.495	-5.214	-6.913

Changes in emissions of households due to altered consumption compositions due to an increase in carbon tax of €5, €10, €15 an €20. The bottom line shows the reductions in economy-wide emissions, i.e. includes the effects of activity-based emissions.

The impacts of an increase in carbon tax by €5 on total emissions is given on the bottom row of Table 11, where emissions are reduced by 1.76%. Given the aforementioned caveats of our methodology, we believe are results are more likely to overestimate the emission reduction associated with an increase in carbon tax than underestimate them. In other words, a €5 increase in carbon tax will in a good case scenario lead to a 1.76% reduction of total non-ETS CO_2 emissions. When doubling carbon tax to a rate of €40 per tonne of CO_2, total emission reduction is estimated at 6.91%. Comparing this to the non-ETS reduction target for Ireland of 20% reduction compared to 2005 levels by 2020, we need to consider how the current level of emissions compared to 2005. CO_2 emissions in Ireland have fallen compares to that of 2005, where (EPA, 2018) estimate that non-ETS emissions have reduced from 47,146 kilotonnes in 2005 to 41,363 in 2014 and 43,810 in 2016. However, the reason for this decrease is believed to be the decrease in economic activity due to the recent economic crisis, where emissions have been increasing steadily over the past years as the Irish economy has recovered. The EPA Ireland estimates that non-ETS emissions in 2018/2019 will be virtually back at the 2005 levels (EPA, 2018). Assuming this, even a doubling of the carbon tax, resulting in 6.91% reduction in total emission will fall far short of the 2020 target.

4 Conclusions

This report investigates the potential economic impacts of an increase in the carbon tax for Ireland using a energy social accounting matrix (ESAM) multiplier analysis. We find that the impact on both producer and household consumer prices are relatively low (under a percentage). Though the methodology of this report has limitations and our results should be interpreted with caution, these results make sense given the relatively low carbon tax on commodities. Only 2.2% of total excise tax are levied based on the carbon content of the commodities. Concerning the distribution of impacts across production

sectors, we find unsurprisingly that the transport sectors are most affected. Our results concerning the impacts of an increase in carbon tax across household income deciles show higher impacts for richer households concerning total consumer prices. When examining consumer prices of heating, we find a virtually uniform impact across income deciles. Hence, our results suggest that an increase in carbon tax will not have higher impacts on more vulnerable households and will not significantly increase fuel poverty.

The limitations of the methodology applied here do not allow for a reliable estimation of GDP impacts of an increase in carbon tax. Given the small impacts on both consumer and producer prices, however, we do not expect significant GDP impacts for an increase in the carbon tax of €5. The potential GDP impacts will also depend on how the government allocates the carbon tax excise receipts, where potential GDP impacts of an increased carbon tax can be mitigated by other policies or reduced taxes funded by these receipts.

Although the estimated emission effects are overestimated since the methodology does not take into account general equilibrium effects, economy-wide emissions can be reduced by 7% in the case of a doubled carbon tax. In addition to strong economic growth which leads higher emissions, it is crystal clear that Ireland is far away from meeting the non-ETS emission reduction targets by 2020 and 2030 even with significant increases in the carbon tax. Both an increased carbon tax over time and a clear message of commitment to the carbon tax into the future will bring Ireland closer to its 2020 emission targets.

Appendix A Compilation steps of the SAM

1. **Activity Accounts (ACT)**

    - Total production (or supply) is consumed by the commodity account. That's why, the sum of the Supply Table appears on the rows of ACT and columns of commodities (COM).
    - Figures on the columns of ACT accounts come from the Use Table's corresponding row sums.
    - Sum of "Net taxes (taxes less subsidies) on production" appears on the ACT columns and the rows of production taxes (PRODTAX).
    - Payments to factors of production constitute gross incomes of factors of production.

2. **Commodity Accounts (COM)**

    - Rows of this account show demand components including trade and transportation margins.
    - In the Supply Table, the values of trade and transportation commodities are entered as negative on the columns of margin. Therefore, the sum of the trade margins column of the Supply Table is equal to zero, by definition. The trade sectors in the SUTs for Ireland are NACE 45 Wholesale & retail trade/repair of vehicles; NACE 46 Wholesale trade, and NACE 47 Retail trade.
    - the margin values for the trade sectors appear on the margins column (MARG) since trade intermediation is a demand component for these sectors' output.
    - Household (including Non-profit Institutions Serving Households-NPISH) consumption, public consumption, investment (including change in inventories) and exports appear on the corresponding columns.
    - On the SUTs, In-kind transfers from the government to households is excluded from household consumption but included in public consumption. In the SAM, the value of in-kind transfers collected from the government accounts is added (subtracted) to (from) private (public) consumption.
    - Figures on the columns come from the Supply Table's corresponding column sums.
    - The margin values demanded by commodities produced by non-trade sectors appear on the margins row (MARG).
    - Net taxes on products appear on the row of sales & excise taxes (SALTAX). This figure includes valued added tax, import tariffs and other indirect taxes on commodities, if any.
    - Figures on the import column of the Supply Table appear on the rest of the world (RoW) row.

3. **Labour (LAB)**

    - This account's row sum is equal to payments to labour by activities.
    - It pays direct tax on wage income and social security contributions to the account of direct taxes (DIRTAX). Total value of direct tax payments is derived from the government accounts.
    - The remaining value goes to households as net wage income.

4. **Capital (CAP)**

    - This account's row sum is equal to payments to capital by activities.
    - It pays direct tax on capital income to the account of DIRTAX. Direct tax paid by capital is calculated as a residual by subtracting income tax of labour from total direct tax revenue of the government.
    - The remaining value goes to enterprises as net capital income.

5. **Enterprises (ENT)**

    - Collects net capital income from the capital account.
    - It also receives transfers from the government. The value of transfers is calculated as a residual to ensure the government account's equilibrium.
    - Total income is split between payments to households as capital income and corporate savings.
    - Savings of corporations are derived from the Quarterly Accounts of Institutional Sectors (QAIS). Payments to households are calculated as residual.

6. **Government (GOV)**

    - All tax accounts pay their revenues to the government.
    - In addition, change in the foreign debt stock of the government appears on the column of RoW and on the row of GOV. This value is collected from the National Treasury Management Agency.
    - Transfers to households comprise of the sum of cash and in-kind transfers collected from the government accounts.
    - The operating surplus / deficit value is directly taken from the government accounts as public savings.
    - The difference between revenues and expenditures is directed to enterprises.

7. **Households (HH)**

   - Revenues of households are net-of-tax payments from the factors of production, transfers from the government and net factor payments / receipts from the RoW.
   - Total revenue is either consumed (coming from the Use Table) or saved (residual).

8. **Rest of the World (RoW)**

   - Export of commodities, net factor payments to abroad and the change in the government foreign debt stock constitute the foreign exchange receipt of the economy and appear on the RoW column's corresponding rows.
   - Imports constitute foreign exchange payments to the RoW and appear on the RoW column.
   - To ensure the consistency, savings from the rest of world, the current account balance in other words, are calculated as a residual.

9. **Savings / Investment (SI)**

   - The column shows total demand of commodities by investment purposes.
   - The row constitutes household savings, corporate savings and savings from the RoW.
   - Since the Irish economy ran a current account surplus in 2014, there is net outflow of savings to abroad, thus the value that appears on the RoW column is negative.
   - Since all other accounts are in equilibrium, the value of foreign savings also equilibrates the saving / investment balance.

Table 12: Aggregated Version of the Irish SAM

	ACT	COM	MARG	LAB	CAP	HH	ENT	PRODTAX	DIRTAX	SALTAX	GOV	SI	RoW
ACT		417,954.1											
COM	240,947.3		25,225.0			87,084.4					26,244.8	45,155.2	216,898.9
MARG		25,225.0											
LAB	73,242.7												
CAP	102,990.8												
HH				45,102.3			64,313.1				28,076.0		-29,715.0
ENT					94,891.3						13,594.9		
PRODTAX	773.2												
DIRTAX				28,140.47	8,099.5								
SALTAX		17,530.4											
GOV								773.2	36,240.0	17,530.4			6,274.0
SI						20,692.0	44,173.0				-7,098.0		-12,611.8
RoW		180,846.1											
TOTAL	417,954.1	641,555.6	25,225.0	73,242.7	102,990.8	107,776.4	108,486.1	773.2	36,240.0	17,530.4	60,817.7	45,155.2	180,846.1

Appendix B Valuation

Trade and transportation margins and net taxes on products (taxes minus subsidies) are one of the basic components of the valuation process. The European System of Accounts (ESA 1995) manual distinguishes two main valuation concepts of the flows of goods and services: purchasers' prices and basic prices:

- **Purchasers' prices:** At the time of purchase, the purchaser's price is the price the purchaser actually pays for the products; including any taxes less subsidies on the products (but excluding deductible taxes like VAT on the products); including any transport charges paid separately by the purchaser to take delivery at the required time and place.

- **Basic prices:** The basic price is the price receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable on that unit as a consequence of its production or sale (i.e. taxes on products), plus any subsidy receivable on that unit as a consequence of its production or sale (i.e. subsidies on products). It excludes any transport charges invoiced separately by the producer. It includes any transport margins charged by the producer on the same invoice, even when they are included as a separate item on the invoice.

The difference between these two basic valuation concepts relates therefore to trade and transport margins on the one hand, and to taxes less subsidies on products on the other. Producers' prices were the main valuation concept in the former system of national accounts. When we also introduce the concept of producers' prices, the difference between these two valuation concepts can be attributed to the two factors.

- **Producers' prices:** The producers' price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer.

Thus, the relationship between the different types of prices can be shown as follows:

Purchasers' prices (excluding any deductible VAT)
- Non-deductible VAT
- Trade and transport margins
= Producers' prices
- Taxes on products (excl. VAT)
+ Subsidies on products
= Basic prices

Appendix C Additional Tables

Table 13: Changes in Purchaser Prices, %

	€5	**€10**	**€15**	**€20**
Agriculture	0.072	0.147	0.224	0.303
Peat	1.134	2.294	3.482	4.698
Coal	1.097	2.218	3.364	4.536
Natural Gas	0.474	0.953	1.437	1.925
Other Mining	0.037	0.075	0.114	0.154
Food, Beverage and Tobacco	0.029	0.059	0.089	0.121
Textile	0.004	0.008	0.013	0.017
Wood and Wood Products	0.048	0.098	0.148	0.201
Other Industry	0.033	0.068	0.103	0.139
Gasoline	1.326	2.688	4.087	5.525
Kerosene	0.530	1.066	1.608	2.156
Fuel-oil	0.089	0.180	0.271	0.364
LPG	1.000	2.020	3.061	4.124
Diesel	1.691	3.439	5.249	7.123
Other Petroleum Products	0.003	0.005	0.008	0.011
Other Manufacturing	0.048	0.096	0.146	0.197
Chemicals and chemical products	0.019	0.038	0.057	0.077
Basic pharmaceutical products	0.016	0.032	0.049	0.066
Rubber and plastics	0.032	0.065	0.099	0.134
Other non-metallic mineral products	0.056	0.113	0.172	0.233
Basic and Fabricated Metals	0.035	0.071	0.108	0.145
High-Technology Production	0.020	0.040	0.061	0.082
Transportation	0.002	0.005	0.007	0.010
Electricity	0.211	0.426	0.645	0.867
Water and Sewerage	0.066	0.135	0.205	0.277
Construction	0.068	0.137	0.209	0.283
Trade Activities	0.040	0.081	0.124	0.167
Land Transportation Services	0.257	0.522	0.796	1.079
Water Transportation Services	0.263	0.535	0.816	1.107
Air Transportation Services	0.228	0.462	0.701	0.946
Accommodation and Related Services	0.074	0.149	0.227	0.307
Telecommunication	0.036	0.073	0.110	0.149
Financial Services	0.015	0.031	0.046	0.063
Real Estate Services	0.011	0.023	0.035	0.047
Public Administration	0.095	0.193	0.294	0.398
Education Services	0.108	0.219	0.333	0.450
Human, Health and Social Work	0.098	0.198	0.301	0.407
Services	0.033	0.067	0.102	0.138

Table 14: Changes in Producer Prices, %

	€5	€10	€15	€20
Agriculture	0.096	0.194	0.296	0.401
Peat	0.120	0.243	0.370	0.501
Natural Gas	0.189	0.381	0.575	0.771
Other Mining	0.058	0.117	0.178	0.241
Food, Beverage and Tobacco	0.048	0.097	0.147	0.199
Textile	0.047	0.095	0.144	0.195
Wood and Wood Products	0.081	0.164	0.250	0.338
Other Industry	0.061	0.124	0.188	0.254
Petroleum	0.043	0.087	0.133	0.179
Other Manufacturing	0.073	0.148	0.225	0.303
Chemicals and Chemical Products	0.032	0.065	0.098	0.132
Basic Pharmaceutical Products	0.019	0.039	0.059	0.080
Rubber and Plastics	0.070	0.141	0.214	0.290
Other Non-metallic Mineral Products	0.087	0.177	0.269	0.364
Basic and Fabricated Metals	0.080	0.162	0.246	0.331
High-Technology Production	0.043	0.087	0.132	0.179
Transportation	0.056	0.113	0.171	0.232
Electricity	0.183	0.370	0.560	0.754
Water and Sewerage	0.067	0.136	0.207	0.280
Construction	0.068	0.137	0.209	0.282
Trade Activities	0.059	0.120	0.182	0.247
Land Transportation Services	0.267	0.544	0.829	1.124
Water Transportation Services	0.288	0.586	0.894	1.213
Air Transportation Services	0.268	0.542	0.823	1.111
Accommodation and Related Services	0.086	0.174	0.264	0.358
Telecommunication	0.048	0.096	0.147	0.199
Financial Services	0.032	0.065	0.100	0.135
Real Estate Services	0.011	0.023	0.034	0.047
Public Administration	0.096	0.194	0.295	0.399
Education Services	0.108	0.219	0.333	0.450
Human, Health and Social Work	0.098	0.198	0.301	0.407
Services	0.039	0.079	0.119	0.162

Table 15: Changes in Activity Based Emissions, %

	€5	**€10**	**€15**	**€20**
Agriculture	-3.107	-6.165	-9.174	-12.134
Peat	-2.257	-4.487	-6.688	-8.861
Natural Gas	-0.575	-1.148	-1.719	-2.288
Other Mining	-1.006	-2.003	-2.991	-3.971
Food, Beverage and Tobacco	-1.339	-2.665	-3.979	-5.280
Textile	-1.114	-2.218	-3.312	-4.396
Wood and Wood Products	-1.360	-2.703	-4.030	-5.340
Other Industry	-1.664	-3.308	-4.931	-6.533
Petroleum	-0.741	-1.473	-2.195	-2.908
Other Manufacturing	-1.381	-2.750	-4.106	-5.450
Chemicals and Chemical Products	-1.231	-2.451	-3.659	-4.856
Basic Pharmaceutical Products	-0.915	-1.825	-2.730	-3.631
Rubber and Plastics	-2.017	-4.009	-5.977	-7.920
Other Non-metallic Mineral Products	-0.810	-1.607	-2.391	-3.162
Basic and Fabricated Metals	-0.801	-1.597	-2.387	-3.172
High-Technology Production	-1.248	-2.485	-3.710	-4.923
Transportation	-1.917	-3.806	-5.668	-7.502
Electricity	-1.534	-3.055	-4.563	-6.058
Water and Sewerage	-2.034	-4.041	-6.021	-7.973
Construction	-2.531	-5.024	-7.480	-9.898
Trade Activities	-1.791	-3.557	-5.299	-7.017
Land Transportation Services	-2.735	-5.431	-8.090	-10.710
Water Transportation Services	-2.711	-5.385	-8.022	-10.621
Air Transportation Services	-1.119	-2.224	-3.314	-4.389
Accommodation and Related Services	-2.109	-4.189	-6.238	-8.257
Telecommunication	-1.600	-3.180	-4.740	-6.280
Financial Services	-1.972	-3.918	-5.836	-7.727
Real Estate Services	-1.243	-2.475	-3.695	-4.904
Public Administration	-1.488	-2.957	-4.407	-5.838
Education Services	-1.180	-2.346	-3.499	-4.639
Human, Health and Social Work	-1.289	-2.561	-3.818	-5.060
Services	-2.608	-5.175	-7.703	-10.190

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Roinn Cumarsáide, Gníomhaithe
ar son na hAeráide & Comhshaoil
Department of Communications,
Climate Action & Environment

Mr Paschal Donohoe
Minister for Finance and Public Expenditure and Reform
Government Buildings
Upper Merrion Street
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27th July 2018

Budget 2019 – Proposed Taxation Measures

Dear Paschal,

Following on from the publication of the National Development Plan (NDP) in March, and our more recent Project Ireland 2040 event – *Empowering Communities for Climate Action* on 20th June, I am now writing to you to set out my views as to how Government, as part of the budgetary and estimates process, could make impactful decisions on taxation measures to support climate action.

Climate change is one of the most critical challenges facing Ireland, and the Government has committed itself to the fundamental societal transformation necessary to achieve a low carbon and climate resilient future. The Government has noted that its first statutory National Mitigation Plan (NMP) does not provide a complete roadmap to achieve the 2050 low carbon objective, but begins the process of development of medium to long term mitigation choices. Having positioned the NMP as a living document, the Government made good on its promise of the ongoing development of climate mitigation policy with the publication of the NDP, which commits €22 billion to climate action investment (€21 billion for climate mitigation and €1 billion for climate adaptation), plus another €8.6 billion specifically for sustainable transport measures, over the next decade. The Government is also establishing a new, competitive Climate Action Fund, with an initial investment of at least €500m, to provide a stimulus for the roll-out of innovative projects that contribute to the achievement of Ireland's climate and energy targets. This truly represents a step-change in climate action, and one on which we must continue to build.

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In this regard, it is clear that reliance solely on Exchequer investment is neither appropriate nor adequate to the scale of the challenge we face, and must be supplemented by taxation, regulatory and behavioural measures, as well as the harnessing of private sector investment. The preparation of Ireland's National Energy and Climate Plan (NECP) – a requirement of the EU's Clean Energy Package – represents the next opportunity to further develop climate mitigation policy. The NECP is at an early stage of development, with a draft to be finalised by end 2018 and the final plan to be developed by end 2019. In terms of climate mitigation policy, the NECP will need to align with, and where possible build on, the NMP and the NDP. Given the significant investment priorities already identified in the NDP, the NECP is likely to have to look to taxation, regulation and behavioural change actions and measures to further develop mitigation policy.

In focusing on taxation in this letter, I am conscious that we need to commence a holistic, strategic review of the evolution of the overall taxation system over the coming decades, to ensure its long-term stability, as well as its alignment with supporting decarbonisation. As part of this exercise, it will be important to ensure policy coherence in the range and type of incentives provided by government including Exchequer-supported expenditure, taxation, regulation and other behaviour change measures. Public procurement and policies on the circular and bio economy are also key in this regard, with the role of taxes to underpin environmentally sustainable consumption patterns requiring further examination. I have asked the Technical Research and Modelling Group (TRAM), operating under the aegis of my Department, to assist with this work. However, there are certain measures on which we can, and should, make early decisions and I have set these out below.

<u>Climate Action and Clean Air</u>

Carbon Tax

The Government has committed, through the NMP, to an ongoing role for carbon pricing as a core element of the suite of policy measures to address and reduce greenhouse gas emissions over time. The outcome of the forthcoming review of the carbon tax, which has been commissioned by the Department of Finance, should provide a robust basis for the Government to provide a clear long-term signal, in the context of Budget 2019, on the future evolution of carbon tax in Ireland. This will ensure that the carbon tax is able to perform its core function of driving changes, over the longer term, in business and household behaviour. In line with consensus on carbon pricing across the EU, a commitment could be made to have a carbon tax rate of not less than €80 per tonne by 2030. In my view, this is best given effect by setting a minimum effective benchmark floor price for a barrel of oil equivalent of €200 (or $230) in 2030, with an associated trajectory to be developed for the intervening period. This would act as a powerful signal for private sector investment decisions, reorienting them towards decarbonising options. The tax rate would be set on an annual basis related to the forecast price for a barrel of oil equivalent in the coming year, with a possibility for

intra-year force majeure adjustments. This novel 'price floor' approach will ensure that fluctuating prices for a barrel of oil equivalent, in particular falling prices, will not frustrate the capacity of a carbon tax to change behaviours and investment decisions.

Nationwide Low Smoke Zone (Coal Ban)
The planned introduction of a nationwide Low Smoke Zone, which will ban the sale of smoky coal country wide, is due to fully come into effect between now and September 2019. My Department has commissioned a study under the TRAM which recommends that it would be prudent to provide a fiscal support measure to underpin the transition to alternative cleaner, lower carbon solid or other fuels. A reduction in VAT on cleaner 'low smoke' solid fuels is recommended to support the necessary transition to cleaner, lower carbon alternatives. In addition, this would moderate the effect of carbon tax on those reliant on solid fuels by reducing the price of cleaner 'low smoke' solid fuels.

Transport Fuels Excise Gap
The alterations to the motor tax regime in the last decade had a far greater impact on the uptake of diesel vehicles than projected. This, along with the excise gap between petrol and diesel, has had the unintended consequence of increasing the up-take of diesel cars by private motorists. During the economic recession, the gap between the excise on petrol and diesel increased offering a further incentive for private motorists to switch to diesel. The resulting increase in the number of diesel vehicles, particularly in cities, is giving rise to health concerns due to health implications of higher NOx (nitrogen oxides) and particulate matter emissions associated with these vehicles. Black carbon from diesel emissions also contributes to warming of the atmosphere. A number of observers, including the OECD and the European Commission, have raised concerns about the justifiability of the excise differential between petrol and diesel on environment and health grounds.

The Government has an opportunity with the procurement of a new National Car Test operator (the process for which I understand is currently ongoing) to revise the testing regime to provide an actual emissions profile for vehicles. This would act as an effective congestion charge, as well as encourage the retrofitting of diesel vehicles, including to alternative fuels, and support the conversion of the fleet over time to petrol hybrids and EVs. This approach has the added advantage of encouraging a voluntary transition over a short period, while ensuring that those who acted on Government policy in the past by purchasing a diesel car are now not seen to be penalised. In Budget 2019, the Government could announce its intention to reform the motor tax regime in tandem with the currently ongoing competitive procurement process for the NCT.

Extension of the VAT Diesel Rebate Scheme to Petrol
The extension of the VAT diesel rebate scheme to petrol consumed in efficient hybrid cars to allow businesses to opt for a clean alternative to diesel vehicles should also be considered in Budget 2019

Energy

In the context of the renewable energy and energy efficiency elements of the EU's Clean Energy Package for 2030, provisional agreements were recently reached at EU level that will establish an EU-wide renewable energy target of 32% by 2030 and an energy efficiency target of 32.5% by 2030. These ambitious targets, which Ireland supported, go beyond those originally proposed by the Commission and have the potential, together with necessary contributions from other sectors, to deliver EU-wide greenhouse gas emissions reductions of up to 45% by 2030.

It will now be necessary for Member States to propose, through their draft NECP, their respective contributions to these EU level targets. The contributions that Ireland will be expected to make towards these 2030 targets, as well as the necessity to make further incremental progress towards our existing 2020 targets, in particular the heat and transport components of the renewable energy target, will require significant and ongoing interventions through the tax system in the years to come.

Decarbonisation of Transport

A range of measures have been introduced to support the decarbonisation of transport, though with time-bound operational periods. However, EVs and other nascent technologies are still at development stage. While prices of fossil-fuelled vehicles (internal combustion engine (ICE)) are expected to rise over the next decade as increasingly stringent emissions and efficiency requirements impact, it is expected that EVs will still have a price premium over ICE cars out to mid-decade. This underlines the need for visible, continued Exchequer support to that point. This could be supplemented by an incremental increase in VRT on ICE vehicles to achieve the Government's objective of no new non-zero emission cars for sale by 2030, and the associated revenue could be used in the short term to fund the Exchequer support for hybrids, plug-in hybrids and EVs.

In the case of road haulage (responsible for approximately 25% of emissions, though only 5% of traffic), EV technology does not yet present a viable commercial haulage scale option, but compressed natural gas (CNG), liquefied natural gas (LNG) and liquefied petroleum gas (LPG) and their biogas equivalent offer significant reductions in emissions per unit of travel. This requires support to promote early stage investment in refuelling infrastructure.

It is important, therefore, that taxation policy:

continues benefit-in-kind relief for fully battery electric vehicles beyond the one year currently provided to end 2018;

continues VRT relief for the purchase of energy efficient hybrid and plug-in hybrid electric vehicles which is currently due to expire at the end of 2018; and

creates a new accelerated capital allowance tax incentive for companies to encourage investment in refuelling infrastructure and equipment for CNG, LNG, LPG and hydrogen.

Decarbonisation of Home Heating and Energy Use

Across the EU, heating and hot water alone account for 79% of total final energy use (192.5 Mtoe). 84% of heating and cooling is still generated from fossil fuels, with only 16% generated from renewable energy. While Ireland will come close to reaching its 40% renewable electricity target for 2020, progress in relation to heating will be lower than target – it is now estimated that we will reach circa 9% renewable heat against a 12% target. Reducing energy needs through better, more efficient technologies, and significantly improved energy retention in heating, are key strategies to enabling Ireland to meet the targets we will adopt to 2030. Household decision-makers have poor direct financial incentives to take a medium to long term view (life-time cost) of their energy consumption decisions, with increased up-front costs overshadowing climate and longer term financial gains. While taxation policy can play a key role in better linking these issues in household decision-making, the Home Renovation Incentive (HRI) also plays an important role in ensuring that renovations are tax compliant and not carried out via black market activity.

Important suggested interventions, to allow the Government to publicly demonstrate commitment to support energy efficient activity in line with its climate goals, include:

repurposing the HRI as a visible, Exchequer-targeted climate mitigation intervention designed to support home renovations that significantly enhance building efficiency performance, including the installation of renewable energy; and

creating a designated tax credit for the purchase of energy-efficient products or services, such as electrical products that have the highest rating level within EU energy labelling legislation, or upgrades that improve the energy efficiency of a person's home.

In line with my earlier statement, further analysis needs to be done to ensure policy coherence with respect to the provision of grants for energy efficiency retro-fitting and any proposed further tax incentives in this area.

I would add that the Behavioural Economics Unit (BEU) in the Sustainable Energy Authority of Ireland (SEAI) is researching and preparing a report of current international evidence on what works when it comes to encouraging sustainable energy behaviours. The report is in an advanced stage of drafting and is expected to be finalised in the coming weeks. Emerging proposals from this report and other work undertaken by the SEAI in this area that merit further analysis by the TRAM include:

> Variable stamp duty: whereby stamp duty is lowered for homeowners who upgrade the energy efficiency of their home and increased by the same amount for inefficient homes could be an effective means of encouraging energy efficiency retrofits. The government could set a benchmark level of energy efficiency based on the BER scale and the stamp duty of newly-purchased homes could then be adjusted accordingly (downwards for homes with higher BERs and upwards for those with lower BERs), compared to the benchmark rating; and
>
> Feebate: a market-based self-financing feebate (sometimes referred to as bonus-malus) system could stimulate consumer investment in more energy efficient appliances. Inefficient products would be taxed and the resulting revenue would act as a rebate subsidy on more efficient products within the same product group.

I propose that consideration should be given to a commitment in the budget statement to work on feebate and more innovative measures such as those outlined above, on encouraging energy efficiency retrofits of homes and business.
In addition, I will further revert to you following the TRAM's analysis on these measures in the context of future budgetary decisions.

National Digital Strategy

In the context of a revised National Digital Strategy, a tax incentive could be introduced to better position Irish based businesses to take advantage of the substantial opportunities of trading online and sustain employment across Ireland. Ireland's digital economy represents over 6% of Ireland's GDP and is growing fast, supporting 116,000 direct and indirect digital jobs currently. Data from the EU Commission's digital economic and social index shows that 32% of Irish SMEs are trading online, while Irish

consumers spend around €7 billion online per annum. Industry bodies such as IBEC and the Retail Forum have made formal submissions to Government specifically calling for changes to the tax code to stimulate sustainable investment in trading online by Irish business.

The Government introduced the Trading Online Voucher Scheme (TOVS) in 2014 which has to date provided training and a financial grant of up to €2,500 to some 4,500 micro-businesses. Analysis of the outcomes of the current scheme show that Irish small businesses, on average, grow by over 20%, increase employment by 35% and 60% begin to export for the first time. Encouraging a greater number and range of businesses to trade online will incrementally increase the macro-economic dividends. The evidence from the current TOVS suggests the positive impact trading online has on business is the same inside and outside of urban settings.

A detailed evaluation of the feasibility of a trading online tax incentive scheme will need to be undertaken to determine if increasing the number and range of businesses that trade online with a tax incentive scheme in provincial towns and rural locations will make a significant contribution to sustainable rural development. The format of the scheme will be derived from an analysis of reference schemes in operation in Ireland and abroad. The timeline for the introduction of any such measure is likely to be Budget 2020 but I believe that it could have a transformational effect on micro and small businesses in Ireland, and would sit well with demand stimulation measures under the National Broadband Plan.

If you are agreeable, I will ask my officials to contact the tax side of your Department to progress consideration of the proposals outlined above.

Yours sincerely,

Denis Naughten

Denis Naughten, T.D.

Minister for Communications, Climate Action and Environment

Submission FIN-00887-18 – Budget 19#13 - Budget Options: Carbon Tax

To: Minister	**Author:** Niall O'Sullivan
Status: For Review by Minister	**Owner:** Sub_FIN Ministers Office
Purpose: For Decision	**Reviewer:** Niall O'Sullivan, Gerry Kenny, John Hogan
Division/Office: Tax Division	
Decision By:	

Minister's Comments:
I am currently minded to implement a €10 increase on budget day. Please inform me of options re rebate scheme for hauliers / bus + view of DSP on best mitigation measures, e.g deferral see May or / & any social welfare changes. Could I be informed of this by middle of this week. Furthermore there are additional ~~P.D~~ measures proposed in DN letter. specifically 16.09.18 ~~he~~ asks for a price floor, lower VAT on lower smoke fuels, & further measures on page 5 ~~8~~ 6 of letter. Could I get views, partic on re-purposing of HMI?

[illegible]

Submission FIN-00887-18 – Follow-up - Budget Options: Carbon Tax

To: Minister	**Author:** Niall O'Sullivan
Status: For Review by Minister	**Owner:** Sub_FIN Ministers Office
Purpose: For Decision	**Reviewer:** Niall O'Sullivan , Gerry Kenny, John Hogan
Division/Office: Tax Division	
Decision By:	

Minister's Comments:
O.K → minded to take route of maintaining 7.5 cent rebate but lowering point @ which rebate kicks in. Just not sure @ what level to so do. Need to get balance right between competitiveness + reducing consumption. Let's discuss Monday + Tuesday. On other issues let's do start date of 1 May + increase in fuel allowance. P.D

20.9.18

For official meeting can they bring along table showing ~~what~~ impact of ~~the~~ £5/£10 move on different fuel forms.

P D 20.9.18

Briefing Material on DCCAE Environmental Tax Proposals

1. Re-purposing of Home Renovation Incentive (HRI)

The Home Renovation Incentive (HRI) allows householders to claim an income tax credit of 13.5% of the total cost of repairs, renovations and improvements to a home (up to a maximum of €30,000 total cost). In parallel, the Government makes grants available to householders who wish to improve the energy efficiency of their home through the Sustainable Energy Authority of Ireland (SEAI).

When the carbon tax was introduced in 2009 there was no HRI and no SEAI grants. Now SEAI operate a variety of programmes to support households who want to reduce their energy usage and thus their exposure to the carbon tax. These range from the Warmer Homes scheme which provides free upgrades for those in energy poverty, to the regular Better Energy Homes grants available to all homeowners. Since the introduction of the carbon tax some 350,000 households (circa 1 in 5) have availed of SEAI energy efficiency grant and these are all still available to households.

A separate submission on the HRI (FB19#9) has been prepared by income tax side.

2. Nationwide Low Smoke Zone (Coal Ban)

DCCAE have requested a reduced VAT rate on 'low smoke' fuels. Solid fuels are already subject to a reduced VAT of 13.5% by way of a derogation from the terms of the VAT Directive and it is not possible to provide them with a rate of less than 12%. The National Mitigation Plan provides for an examination of fossil fuel subsidies and the existing reduced rate of VAT on solid fuels would already fall to be classified as such.

The low smoke ban, introduced in Dublin in 1990, already applies to all urbanisations and large towns in Ireland, and this is being extended nationwide between now and September 2019. It remains the position of the Department that this is an area best addressed through legislation rather than taxation.

3. Stamp Duty

A system of variable stamp duty is proposed to encourage homeowners to retrofit their properties, with the quantum of stamp duty linked to the BER rating of the home. While nominally it is the buyer who would benefit from the reduced stamp duty applied to the purchase of a BER 'A' rated home, in reality it is the seller who would benefit through being able to increase the value of their home by the reduced stamp duty amount.

The issue of deadweight cost arises – there is a financial incentive to invest in home insulation in any event and this type of measure would only serve to marginally increase that existing incentive. Some, of course, would already have top BER ratings and as such would nominally receive an immediate boost from the introduction of such a measure. Therefore the deadweight cost may be significant with such a scheme and the additional home investment it generates may be commensurately marginal.

It is understood that this type of proposal emerged from a UK think tank, was subsequently discussed in the UK parliament in March 2018, but has not been acted upon. Potential negatives

raised by construction industry stakeholders centred on drawbacks relating to lower value homes where the differential between the most and least energy efficient home would be in hundreds rather than thousands and those under the stamp duty threshold which would not benefit at all. At the higher end, there was speculation that the cost of energy saving measures would outweigh any relief due.

There are other potential issues with this proposal, such as the fact that it may be a regressive type of tax expenditure, given that stamp duty is based on value and given that those who can most afford to invest heavily in home insulation will benefit most.

4. Carbon Tax and 'Price Floor' Approach

DCCAE propose that the carbon tax rate should adjust annually according to the forecast price of a barrel of oil equivalent in the coming year, with a possibility of intra-year force majeure adjustments.

Carbon pricing mechanisms are different for the ETS and non ETS sectors. In particular there has been sustained criticism of the ETS - that the excess of emissions permits has served to reduce the price of carbon well beyond the optimal level. The ultimate purpose of a carbon price floor (CPF) mechanism is to ensure that the price of carbon remains sufficiently high to encourage low carbon investment.

The discussion on the introduction of a CPF has focussed on ETS sectors rather than in relation to national carbon taxes applied to non ETS sectors. The UK already applies a CPF in relation to its ETS sector, while France – who generate about 90% of their electricity from renewable sources – are leading calls for its introduction at EU level.

A 2018 Briefing Paper on the UK CPF prepared for the UK Parliament[1] summarised the view on its CPF as follows: *"There are mixed views on the CPF. Critics says the CPF has done little to reduce emissions, has disadvantaged UK companies and led to increased costs to bill-payers. Many power companies however support the CPF as a mechanism to encourage low-carbon investment, and some environmental groups support the aim of the policy."*

The Climate Change Advisory Council recommended the introduction of a CPF in the ETS sector and contextualised this as follows: *"Analysis suggests that the best way to achieve the ending of the burning of coal at Moneypoint by 2025 would be to introduce a carbon price floor in Ireland alongside other European countries. The government should actively work with other European countries towards this goal."*[2]

The concept of a CPF could also be applied to the non ETS sector, though doing this without doing likewise in relation to coal and peat burning power plants – fuels deemed to be the most damaging to the environment – could be a measure open to criticism.

More generally, a long term trajectory for the carbon tax requires further analysis, including in relation to economic and social impacts, and the ESRI is currently developing a multi annual model which may better inform decision-making in this regard.

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[1] http://researchbriefings.files.parliament.uk/documents/SN05927/SN05927.pdf

[2] http://www.climatecouncil.ie/media/CCAC_AnnualReview2018.pdf

5. Accelerated Capital Allowance Tax Incentive for Alternative Fuels

Section 46 of the Finance Act 2008 provides that companies may claim 100% of the capital cost of certain energy efficient plant and machinery against corporation tax in year of purchase. The purpose of the ACA scheme is to encourage businesses to purchase plant and machinery that is highly energy efficient and thus make significant savings on energy costs and reduce carbon emissions.

Business Tax side are preparing a separate submission covering this tax incentive. It is expected to be ready this week.

6. National Digital Strategy – Tax Incentives for Trading Online

DCCAE have proposed to introduce a scheme to incentivise small and medium sized enterprises to trade online. It is worth noting that tax expenditures are used where there is a demonstrable market failure. It should be clear that there is in fact a market failure prior to the proposed incentive being considered. State Aid notification would also be required where a tax credit for SMEs is concerned.

There are currently a number of tax incentives already available to Small and Medium Enterprises within the tax system.

- The Three Year Start Up Relief (Section 486C TCA 1997) provides for relief from corporation tax for start-up companies in their first three years of trading.
- The Start Up Refunds for Entrepreneurs (SURE) is an income tax incentive aimed at encouraging individuals to become entrepreneurs.
- The Key Employee Engagement Programme (KEEP) incentive aims to support SMEs in Ireland in the recruitment and retention of key employees through share options.
- The Employment and Investment Incentive (EII) is an income tax relief incentive scheme that provides tax relief for investment in certain corporate trades and is targeted at job creation and retention.
- The Foreign Earnings Deduction (Section 823A TCA 1997) provides relief from tax on up to €35,000 of salary for employees who travel out of State to certain countries on behalf of their employer.

Furthermore, the Department of Business, Enterprise and Innovation website states there are over 170 different Government supports for Irish start-ups and small businesses.

7. Designated Tax Credit for Purchasing Energy Efficient Products

The question of deadweight cost arises in relation to this proposal as there is already a financial incentive to buy ‘A’ energy rated products - for those that can afford to do so.

EU Product Regulations may be a more effective and cost efficient means of improving the energy rating of products sold to consumers, by progressively forcing product manufacturers to raise their standards in this regard.

The introduction of a new tax credit in this manner, which would presumably be applied to the purchase of many thousands of products sold by many retailers, would likely significantly add to the administrative burden.

An analysis of the operation of any such tax credit in other Member States would be necessary to ascertain the efficacy of such a tax expenditure.

8. Feebate

This proposal has a similar objective to Tax Credit for Purchasing Energy Efficient Products. The theory behind such a system is that inefficient products face an additional tax or levy which is passed on to subsidise energy efficient products. Similar issues would appear to arise as with a designated tax credit for purchasing energy efficient products.

On the face of it, it is unlikely Revenue could administer such a system.

An analysis of the operation of any such scheme in other Member States would be necessary to ascertain the efficacy of such a tax expenditure.

Co-ordinated by Excise Section

20 September 2018

Budget Options: Potential mitigants to a €10 increase in the Carbon Tax

Submission 0887-18 set out some measures which could soften the impact of an increase in the carbon tax for certain cohorts who may be particularly adversely affected by an increase. As requested, further detail is set out below on these measures.

Solid Fuels and 1 May 2019 commencement date

1.1 Paragraph 5.4 of Submission 0887-18 noted that increases in the solid fuel carbon tax have historically been implemented from 1 May of the following year. This practice has been informed by a view that poorer households are, on average, more dependent on solid fuels like coal and peat for home heat.

1.2 The National Strategy to Combat Energy Poverty 2016-2019 validates this view where it comments that: *"data suggests that energy poverty levels may be strongly correlated with fuel source. In short, it appears that those households using oil or solid fuel as their primary heating source are more likely to be at risk of energy poverty."*[1]

1.3 Implementing an increase to the carbon tax rate on 1 May 2019 at least allows a full winter season to lapse. This delay could reduce receipts by some €3-4m.

National Fuel Scheme

2.1 The fuel allowance is a payment under the National Fuel Scheme to help with the cost of heating homes during the winter months. It is paid to people who are dependent on long-term social welfare payments and who are unable to provide for their own heating needs. It is a means-tested payment. Those in receipt of non-contributory social welfare payments are accepted as satisfying the means test. Persons in employment support scheme or receiving a back to education allowance are entitled to keep the Fuel Allowance if they meet the conditions. Only one fuel allowance is paid to a household.

2.2 As of July 2018 the recipient numbers on fuel allowance were 375,445. The current fuel allowance is paid at €22.50 per week for 27 weeks at an estimated total cost of €227m to the Exchequer per annum.

2.3 The ESRI review suggests that an increase of €10 in the carbon tax rate would add c€33 per annum to the energy costs of households in the lowest income decile and c€47 per annum to households in the second lowest income decile. Energy costs is taken to mean home heat and transport. By way of illustration, a €10 increase in the carbon tax rate would add €50 (VAT incl.) to the annual energy bills of a household consuming about 1,750 litres of kerosene for home heat.

2.4 An increase of €2 would thus boost incomes for fuel allowance recipients by €54 per annum at an estimated cost to the Exchequer of circa €20.3m.

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[1] https://www.dccae.gov.ie/documents/A%20Strategy%20to%20Combat%20Energy%20Poverty.pdf

Diesel Rebate Scheme

3.1 The Diesel Rebate Scheme, introduced in 2013, offers a rebate to qualifying hauliers and bus operators when the retail price of diesel exceeds €1.23 per litre. The rebate amount increases gradually to a maximum rebate of 7.5c per litre when diesel reaches €1.54 per litre. Currently the average retail price of diesel is about €1.36, which entitles qualifying businesses to a rebate of about 3.1c per litre.

3.2 The relatively low price of oil has resulted in very low scheme costs over recent years (€1.3m in 2016; €964,000 in 2017; less than €400,000 for first half of 2018). It is also understood that not all businesses who would qualify for the scheme choose to apply, and that some qualifying businesses continue to purchase some of their fuel abroad (e.g. the price of diesel is significantly cheaper in Luxembourg).

3.3 For any retail price increase between €1.23 and €1.54 the scheme will rebate 24.4% of that price increase. Therefore, without any change to the current rate, the scheme will absorb a reasonable portion of carbon tax induced price increases. Revenue estimates that – assuming a carbon tax increase of €10 was passed through in full to the end retail diesel price – the additional full year cost to the scheme would be in the region of €3m.

3.4 The IRHA has called for the entry price point to the scheme to be reduced from €1.00 (VAT excl.) to €0.85 (VAT excl.) and the cap to be increased to 15c. This would significantly increase the current and longer term Exchequer exposure to the scheme.

3.5 If you are so minded to enhance the scheme for qualifying businesses, an alternative approach to doing so is simply to increase the rate whilst maintaining the current entry price point and cap.

3.6 The tables below illustrate the extent to which the diesel rebate scheme can absorb increases in the retail price of diesel arising from increases in the carbon tax. The tables are based on current prices and show current and increased diesel rebate rates.

Option 1: Current Rebate Rate: effective 24.4% of marginal price increase (or 30% VAT exclusive)

	Add: Carbon Tax Increase	Less: Additional Diesel Rebate	Absorbed by business
€5 increase	1.64c	0.4c	1.24c
€10 increase	3.28c	0.8c	2.48c

Option *2: Increase Rebate Rate to effective 28.5% of marginal price increase (or 35% VAT exclusive)*

	Add: Carbon Tax Increase	Less: Additional Diesel Rebate	Absorbed by business
€5 increase	1.64c	0.47c	1.17c
€10 increase	3.28c	0.93c	2.35c

Option 3: Increase Rebate Rate to effective 33.3% of marginal price increase (or 41% VAT exclusive)

	Add: Carbon Tax Increase	Less: Additional Diesel Rebate	Absorbed by business
€5 increase	1.64c	0.55c	1.09c
€10 increase	3.28c	1.09c	2.19c

3.7 In the above tables, it is assumed that the maximum rebate of 7.5c per litres is not increased. The impact of this shown in the table below:

Option	**7.5c rebate cap kicks in at…**
1	€1.54
2	€1.50
3	€1.46

3.8 Maintaining the cap at 7.5c while increasing the rate would thus serve to reduce Exchequer exposure, though the price point at which the cap kicks in would still be substantially higher than the current average retail price.

3.9 The annual cost of the scheme is dependent on the world price of oil, on the level of participation by those who nominally meet the qualifying criteria for the scheme, and on the level of fuel consumption by claimants related to fuel purchased in the State. As such it is difficult to estimate cost to the scheme of any increases.

3.10 During 2014 the retail price of diesel was around the €1.45 to €1.55 level, significantly above the current average retail price and €21m was rebated. When the scheme was under consideration in 2012, and diesel prices were relatively high, it was estimated that the annual cost could be as high as €70m. The impact of scheme participation is a big exposure.

3.11 Assuming the change in the average retail price of diesel is a result of the additional carbon tax only (at a €10 increase), Revenue estimate that the additional cost to the scheme of options 2 and 3 would be about €4m and €7m respectively. [option 1 is about €3m]. It has been assumed that 320m litres of diesel would be claimed annually in these scenarios.

3.12 You may wish to discuss with officials.

Excise Section

20 September